RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Vol. 61 AUGUST, 1953 No. 2

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Roentgen Differentiation of Pulmonary Tension Disorders in Infants and Children[1]

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TENSION DISORDERS arising in the pulmonary parenchyma and pleural cavity in infants and children are produced by a variety of causes which show similar roentgen findings. These occur as distinct areas of radiolucency caused by encysted or diffuse trapped air under pressure. The expansile characteristics (1) are produced by a check-valve mechanism in the bronchial tree, the interstitial substance of the lung, or the pleural space.

When such a condition is discovered in a critically ill infant with respiratory and circulatory distress, the problem of radical surgical intervention *versus* conservative management arises. Since the natural history of these lesions allows some of them to regress spontaneously (2), while others progressively jeopardize the life of the patient (3), the need for critical roentgen analysis is obvious.

These disorders are either of congenital or acquired origin. Such a distinction is vital to prognosis and treatment, in that the congenital type generally requires major surgical correction while the acquired type does not. The possibility of roentgen differentiation depends largely on a knowledge of the pathological aspects.

With this point in mind, the numerous descriptive expressions (4–8) in the medical literature have been correlated according to their clinical, roentgen, and pathological manifestations, and the following classification has been made.

Congenital Type
- Developmental bronchial malformations
  1. Locular bronchial cysts
     - (*a*) Solitary cysts
     - (*b*) Cystic bronchiectasis
     - (*c*) Congenital honeycombed lung
  2. Cystic hamartomas
  3. Sequestration of lung

Acquired Type
- Interstitial and pleural air cysts
  1. Regional obstructive emphysema
     - (*a*) Postinfectious pneumatoceles
     - (*b*) Interstitial bullae
     - (*c*) Subpleural blebs
  2. Tension pneumothorax
  3. Diffuse obstructive emphysema
  4. Acquired honeycombed lung

PATHOLOGICAL DIFFERENTIATION

Congenital Group: All of the congenital tension disorders manifest in early infancy are due to developmental bronchial malformations (9). The most frequently encountered are the locular bronchial cysts. These form as a result of embryonic blockage in the lumina of the bronchial buds. Single or multiple cystic cavities lined with bronchial structures and filled with secretion are formed peripherally.

Norris and Tyson (10) have shown by an ingenious study of serial sections that the

[1] From the Department of Radiology, Indiana University Medical Center, Indianapolis, Ind. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

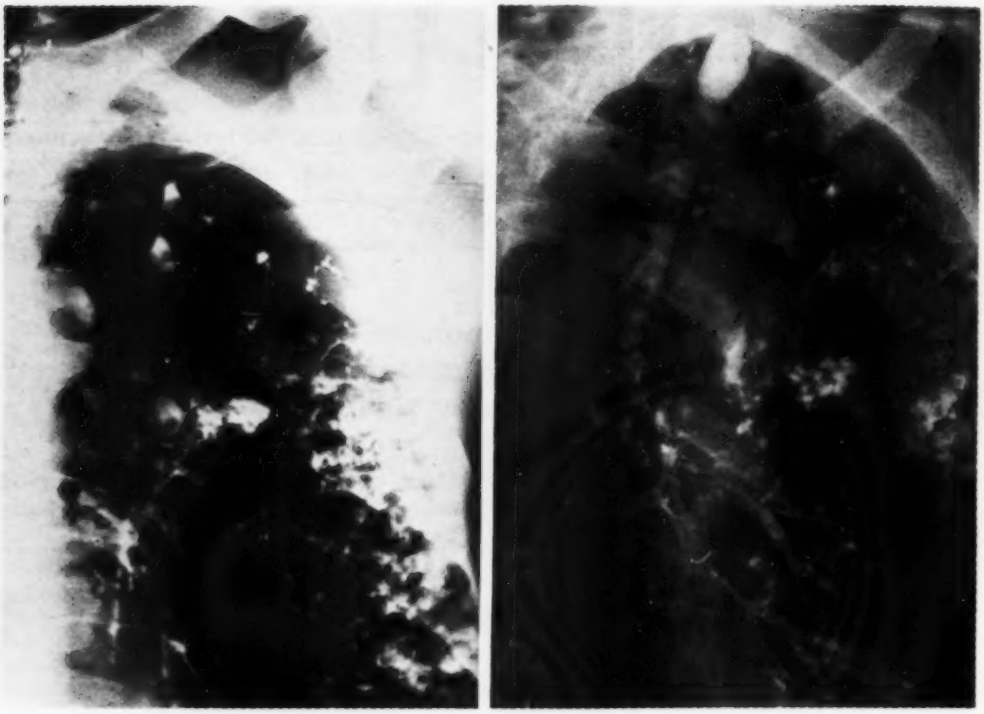

Fig. 1. Focal bronchial anomaly demonstrated on bronchogram. This bronchographic finding in the left upper lobe represents localized fetal (cystic) bronchiectasis. There are focal dilatations of two small bronchioles, both tubular and saccular in type.

original defect is a small irregular dilatation in the bronchioles. Such a focal dilatation, if arrested at that stage, results in the so-called fetal or cystic bronchiectasis (Fig. 1). This condition is characterized by uniform thin-walled cysts ranging from a few millimeters to a centimeter in diameter, diffusely distributed throughout the terminal arborizations of one or more lobes of the lungs.

Where the process continues, these bronchiolar dilatations become pinched off to form gradually enlarging cysts. If the process is diffuse, the congenital form of honeycombed lung results, with numerous expanded cysts, 3 or 4 cm. in diameter, disseminated throughout the lungs. In honeycombed lung, there is generally only a check-valve communication between the cystic cavities and the bronchioles, in contradistinction to cystic bronchiectasis, where complete patency exists.

Most frequently, the focal segmentation process is isolated and a single bronchial cyst results. The postnatal behavior of such a cyst is dependent on mechanical influences. If the obstructed bronchial lumen is forced open, the fluid is evacuated and replaced by air. Symptoms occur when, as a result of check-valve mechanism within the narrow tortuous bronchial lumen, the cyst distends with air sufficiently to produce respiratory or cardiac distress.

A less frequent type of bronchial malformation in this group is the cystic hamartoma or hyperplasia of the lung (11), observed almost exclusively in premature infants. It is characterized by a marked proliferation of embryonic lung tissue resembling normal adult lung except that it is composed of an organoid overgrowth of the terminal bronchioles surrounded by tiny alveolar lobules. This results in enlargement of all or part of the lobe involved.

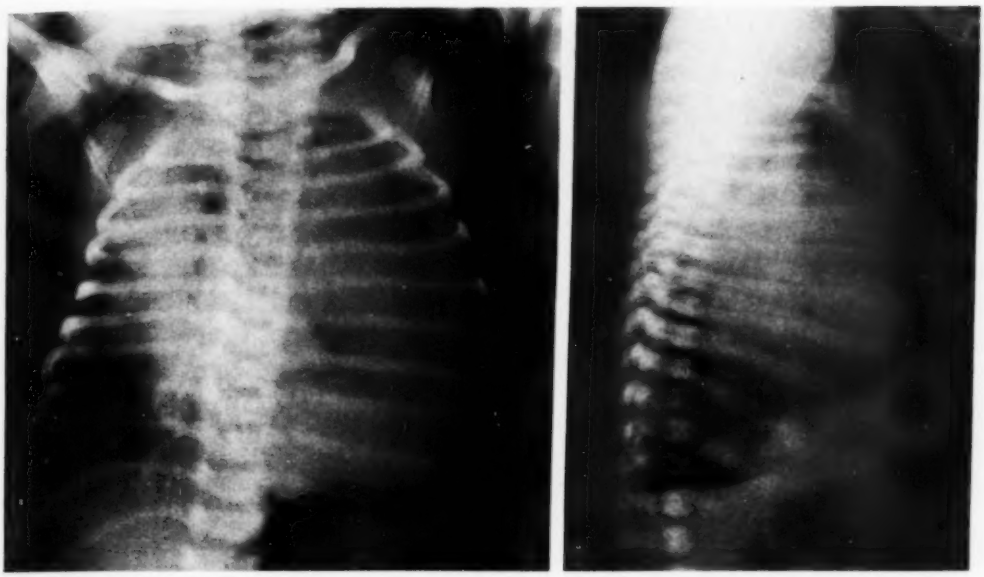

Fig. 2. Non-communicating cystic hamartoma. The anomalous lobe is expanded and dense, resembling tumor. This type occurs when bronchial communication is not established, and the mass becomes completely filled with fluid secretions, producing a density instead of a hyperventilated area on the roentgenogram. (Compare with Fig. 10.)

This mass may be hyperventilated with air or completely filled with secretions, depending upon the patency of its bronchial communication (Fig. 2).

A rare type of bronchial malformation which may show tension cystic manifestations is sequestration of the lung (12). This arises as an anomalous segment of one of the lower lobes, which is sequestrated or dislocated from the normal bronchial and blood supply of the surrounding lung. Its bronchial drainage is aberrant and its blood supply is derived from an abnormal systemic pulmonary artery arising from the abdominal aorta. This blood vessel may pass through the diaphragm or mediastinum to reach the sequestration, an important consideration if surgery is contemplated. Multiple bronchial cysts showing expansile characteristics are usually to be found in the sequestrated lung.

Acquired Group: The acquired lesions account for the majority of pulmonary tension disorders in infants and children. They show a lining of compressed alveolar cells in a web of interlacing pulmonary tissue, or they may be wholly or partially bounded by the pleural surfaces. Their walls are limited to one or two cell layers in thickness and frequently show a black discoloration due to anthracotic pigment. The largest portion of the acquired group is comprised of various forms of regional obstructive emphysema (13).

The commonest form of obstructive emphysema is the postinfectious pneumatocele. This is a hyperventilated cavity deep in the pulmonary tissue. It was described by Doub (14), in 1928, as lobular alveolar emphysema. Caffey (15) and others (16) believe that pneumatoceles constitute a special form of bullous or regional obstructive emphysema resulting from check-valve obstruction produced by thick bronchial exudate and edema in a small bronchus supplying an area of interstitial pneumonia. This causes formation, in the infected portions of the lungs, of one or more round radiolucent areas which enlarge rapidly and may contain air for a considerable time after the pneumonic density has disappeared. The resultant increased pressure and infection aid in obstructing the intralobular communicative

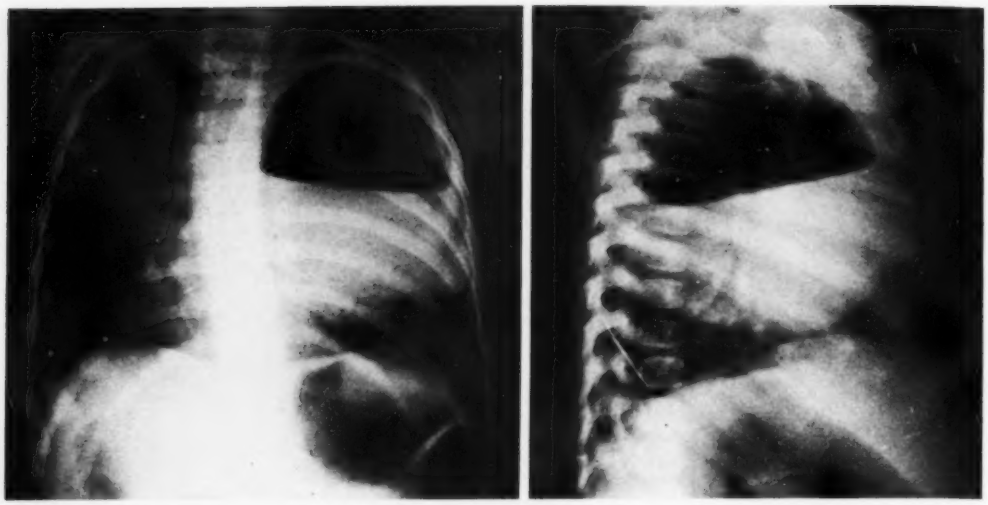

Fig. 3. Tuberculous pneumatocele. Pneumatocele occurs as a single isolated parenchymal cavity in localized bronchial tuberculosis. There is usually no surrounding infiltrate, and differentiation from congenital cyst or bullous cavity will depend on the changing size, presence of fluid levels, and clinical findings.

channels and allow rupture of the intra-alveolar septa, with formation of larger cystic spaces. These cavities may contain fluid levels and be mistaken for necrotic abscesses.

Although such tension pneumatoceles may occur with any form of pneumonic infection, including tuberculosis (Fig. 3), they are more frequently seen during the course of staphylococcic pneumonia (17). In fact, whenever a pneumatocele of this type is encountered, staphylococcic pneumonia should be strongly suspected as the causative factor. With the striking decrease in pneumococcic infections since the use of antibiotics, there has been a relative increase in the incidence of staphylococcic pneumonia seen roentgenographically in infants. Benward (18) reports that 75 per cent of cases involve infants under one year of age, and Forbes (19) states that 95 per cent of infants under six months in whom empyema developed had staphylococcic pneumonia.

The non-infectious counterpart of the pneumatocele is the interstitial bullous cavity. This is due to fragmentation of the interstitial elastic tissue resulting from increased intra-alveolar pressure. The air within the bullous cavity is intra-alveolar and the wall contains no epithelial lining. Such interstitial cavities may be single or multiple. They may coalesce to form larger multilocular rarefactions, the exact margins of which are difficult to establish. The obstructive bronchial mechanism related to their formation is usually so complete that they rarely evacuate themselves through the bronchus (20). Instead, the air contained in them may dissect along the interstitial tissue planes and become loculated in the form of subpleural blebs (21). Such blebs are more commonly seen in the apical and diaphragmatic portions of the lung.

The next most common lesion encountered in the acquired group is non-traumatic tension pneumothorax. This condition, like the pneumatocele, is frequently postinfectious in origin. According to Potts and Riker (22), it may be an early roentgen manifestation of a staphylococcic pneumonia or abscess.

It follows a check-valve bronchopleural fistula incident to rupture of a suppurative parenchymal lesion or tension cystic lesion in the periphery of the lung. Because of previously formed adhesions within the pleural cavity, a tension pneumothorax may expand without establishing free com-

munication with the entire pleural space. Sometimes several loculated cyst-like areas develop which are separated by elongated pleural trabeculations. On rare occasions, an extrapleural tension loculation may result from a mediastinal fistulous tract involving the esophagus or trachea.

Acquired obstructive emphysema is a familiar cause of marked pulmonary hyperventilation which deserves consideration in the differential diagnosis of these tension disorders. It usually follows a check-valve impaction of an aspirated foreign body or extrabronchial compressive obstruction involving the primary or secondary bronchi. This causes progressive emphysematous expansion of part or all of one lung, lasting for forty-eight to ninety-six hours, and followed by atelectasis of the involved area.

Some authors (23, 24) feel that not all cases of honeycombed lung are properly classified as congenital in origin, and cite cases associated with other systemic disorders such as xanthomatosis, fibrocystic disease of the pancreas and liver, and tuberous sclerosis. They conclude that most cases of honeycombed lung are acquired from previous inflammatory disease and that the lung changes result from interstitial fibrosis or bronchiolitis fibrosa obliterans with subsequent diffuse parenchymal cyst formation. We have, therefore, included this entity in our classification as occurring in both congenital and acquired forms.

ROENTGENOLOGIC DIFFERENTIATION

In spite of the extensive descriptive literature on the various entities which give rise to pulmonary tension cysts, it has been our experience, as well as that reported by others (3, 22) to mistake large acquired bullae, or infectious pneumatoceles, and tension pneumothorax for progressively enlarging congenital cysts, necrotic cavities, or even diaphragmatic hernia. This error has led to needless radical surgery for lesions which would have regressed spontaneously. Similarly, because of faulty roentgen analysis, a radical surgical procedure was employed when simpler procedures such as siphon drainage, thoracentesis, bronchoscopy, or medical management might have sufficed. Roentgen examination offers the best means of differentiating the surgical from the nonsurgical lesions. There are certain nonspecific and collateral roentgen findings mentioned in the literature which may aid in the recognition of congenital cystic lesions. They are as follows:

1. Appearance in the newborn or in the first weeks of life
2. Occurrence before a known episode of infection
3. Growth of lesion commensurate with growth of lung
4. Absence of collateral inflammation
5. Trabeculation by septate lung markings
6. Fluid levels rare except in presence of infection
7. No spontaneous regression in size
8. Rupture to form tension pneumothorax rare
9. Fulminating tension states which progress rapidly

Differentiation is better facilitated by considering these lesions in anatomical groupings according to their extent and gross roentgenologic appearance. This narrows the field to a few lesions in each group and allows more critical differential diagnosis.

The following groupings are useful for this purpose:

Group I: Clear Cystic Rarefactions
1. Loculated congenital cysts
2. Tension pneumothorax
3. Solitary bullae or blebs
4. Postinfectious pneumatoceles
5. Sequestration of lung

Group II: Unilateral Diffuse Rarefactions
1. Cystic hamartomas
2. Obstructive emphysema

Group III: Bilateral Diffuse Rarefactions
1. Cystic bronchiectasis
2. Honeycombed lung
3. Asthmatic or croupous emphysema

Clear Cystic Rarefactions: In Group I, there is need first to differentiate between solitary congenital cyst, subpleural blebs, and tension pneumothorax. All of these produce large, extremely clear areas of rarefaction and may rapidly give rise to

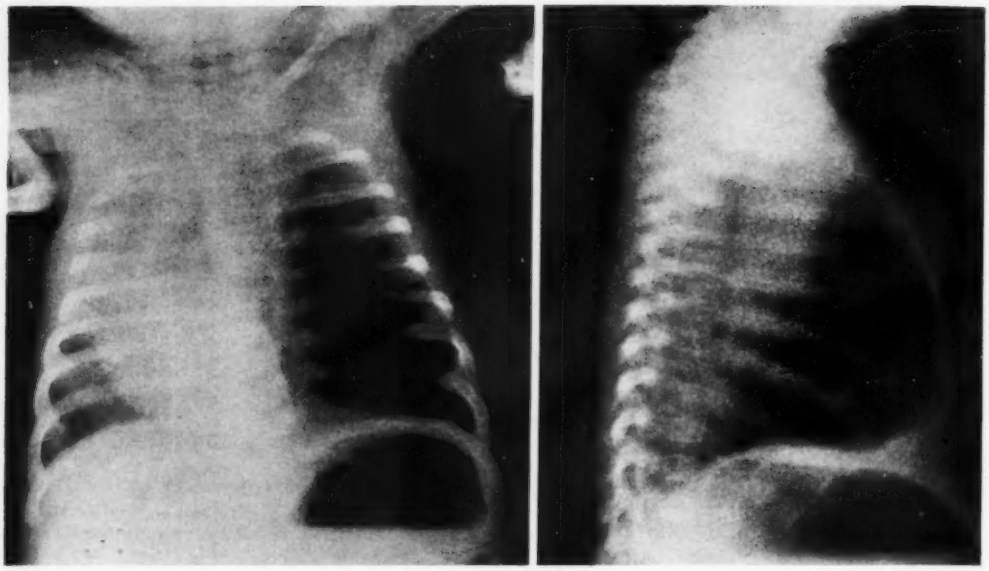

Fig. 4. Solitary bronchial cyst. This patient had severe respiratory difficulty due to a congenital cyst of the left lower lobe under check-valve tension. Note compressed lung segments present in apex and base but absent at the hilus. There is absence of the pleural line over the collapsed lung.

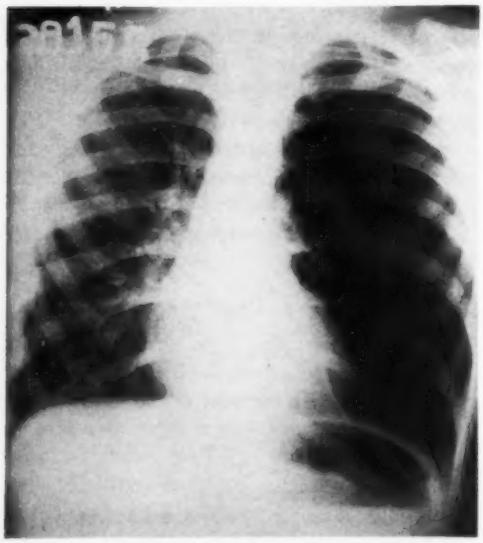

Fig. 5. Solitary bronchial cyst. There is a large cystic rarefaction under tension on the left. It displaces the heart and mediastinum, but does *not* herniate across the mid-line, which aids in distinguishing it from tension pneumothorax. This proved to be a congenital cyst of the left lower lobe.

alarming respiratory embarrassment. Solitary congenital cysts and tension pneumothorax produce the largest areas of involvement of this type and cause marked rib separation, diaphragmatic compression, and mediastinal displacement.

The check-valve mechanism of the cyst causes a huge tension cavity which greatly distorts the lobe in which it arises (Fig 4). Frequently, these cysts will expand to occupy the entire hemithorax but do not herniate across the anterior mediastinum (Fig. 5).

When a loculated tension cyst arises in the extreme periphery of the lung (25), it may cause stretching of the overlying visceral pleura so as to completely occupy the pleural cavity. In such an instance, the surrounding normal lung does not collapse but is compressed against the mediastinum and becomes invisible. The area of rarefaction produced is extremely clear. An identical situation may arise from a huge solitary subpleural bleb. These forms closely resemble tension pneumothorax.

The congenital cyst may be distinguished from tension pneumothorax or an excessively enlarged bleb by the following characteristics. First, there may be discernible areas of lung tissue at the apex or in the

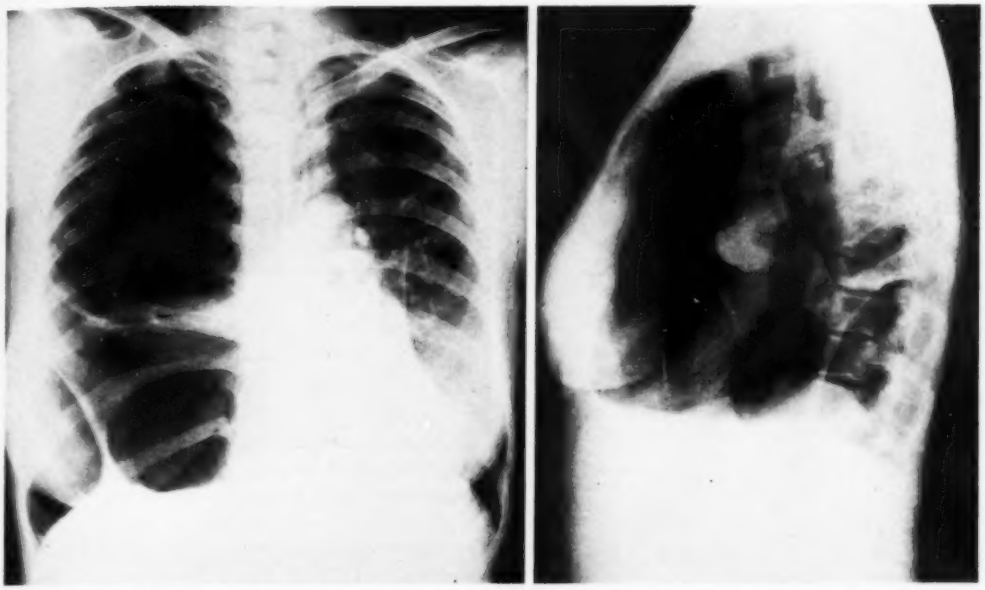

Fig. 6. Loculated tension pneumothorax. The large tension cavities are formed by long pleural adhesions across the pneumothorax space. The extreme clarity of the areas, together with the continuity of the pleural lines over the stretched lung, is a distinguishing characteristic.

angles of the thorax, with absence of collapsed lung at the hilus. The unaffected lung is compressed, but not collapsed as in pneumothorax. In addition, one may see irregular dense lines of several incompletely formed trabeculations stretched obliquely across the illuminated area. Some of these represent the bronchovascular structures leading to the surrounding lung tissue. Still further distinction may be made by noting the absence, around the collapsed lung, of a clear outline of the pleura, which is visible in most instances of pneumothorax. There is usually a very distinct herniation of the pleural sac across the anterior mediastinum in tension pneumothorax, a feature which is absent or much less striking in congenital cyst. Even when a tension pneumothorax cavity is partitioned into cyst-like compartments by pleural adhesions, one should be able to make out the continuity of the pleural line over the collapsed portions of the lung (Fig. 6). In contradistinction, the boundary between the bullous cavity and the adjacent emphysematous lung is difficult to follow as a continuous line. When such a border is visible, it is exceedingly thin and appears irregular at the points where the pulmonary septa project into the air-containing cavity.

The differentiation may sometimes be aided by direct needle aspiration of the cystic cavity followed by injection of a small quantity of iodized oil. In tension pneumothorax, the injected oil follows the pleural contours of the collapsed area, whereas in the cyst it will outline the circumscribed limits of this uncollapsed cavity.

The postinfectious pneumatocele may be distinguished in Group I cases by the surrounding inflammatory infiltrate and the characteristic changes in its appearance on a sequence of roentgenograms. When a pneumatocele is suspected, conservative measures and serial roentgenograms are indicated. During the initial consolidative phase of an interstitial pneumonia, such a lesion has the appearance of air bubbles deeply seated in the lung parenchyma. During the phase of consolidation, a small, poorly outlined spherical cavity is seen. With resolution of the consolidation, a

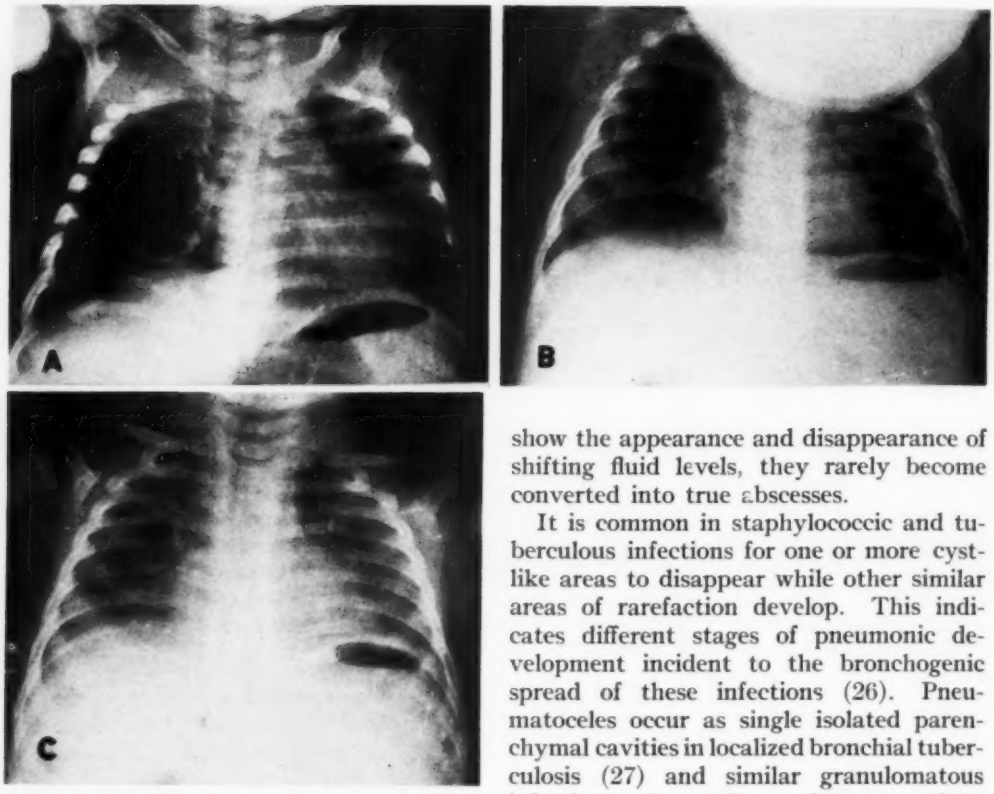

Fig. 7. Post-infection pneumatocele. A. There is a distinct circular radiolucent area in the right lung which appeared during the course of a pneumonia. Note the surrounding infiltrate and the infiltration in the left lung. B. One week later. The infiltration has partially resolved and the pneumatocele is reduced in size. C. Two weeks later. The infiltration has resolved and the pneumatocele is now substantially smaller.

vivid thin-walled cyst is formed that is first surrounded by a wide margin of lung tissue, but may rapidly enlarge under tension so as to fill the entire lobe. Only at this stage is a problem in differentiation created, but identification may be established in the following ways.

The pneumatocele may vary greatly in size from day to day, occasionally ballooning up to alarming proportions. Suddenly it may disappear entirely because of loss of the valvular mechanism in the bronchus, with immediate re-expansion of the surrounding lung. It is usually not accompanied by large areas of lobular atelectasis. Although the pneumatoceles frequently show the appearance and disappearance of shifting fluid levels, they rarely become converted into true abscesses.

It is common in staphylococcic and tuberculous infections for one or more cyst-like areas to disappear while other similar areas of rarefaction develop. This indicates different stages of pneumonic development incident to the bronchogenic spread of these infections (26). Pneumatoceles occur as single isolated parenchymal cavities in localized bronchial tuberculosis (27) and similar granulomatous infections. In such an instance, there will be no surrounding inflammatory infiltrate and differentiation from a congenital cyst or bullous cavity will depend upon changing size, presence of fluid levels, clinical findings, and absence of the lesion on previous roentgenograms (Fig. 7).

The vast majority of pneumatoceles disappears spontaneously as the infection subsides, although they may persist in the roentgenogram for several months after disappearance of the inflammatory densities. Following collapse or gradual disappearance of the cyst, the walls are impossible to find in the subsequent radiographs.

Occasionally, a recognized pneumatocele ruptures to form a tension pyopneumothorax. More frequently, the reverse situation occurs, however, in which an unexplained tension pneumothorax or empyema is the initial roentgen finding.

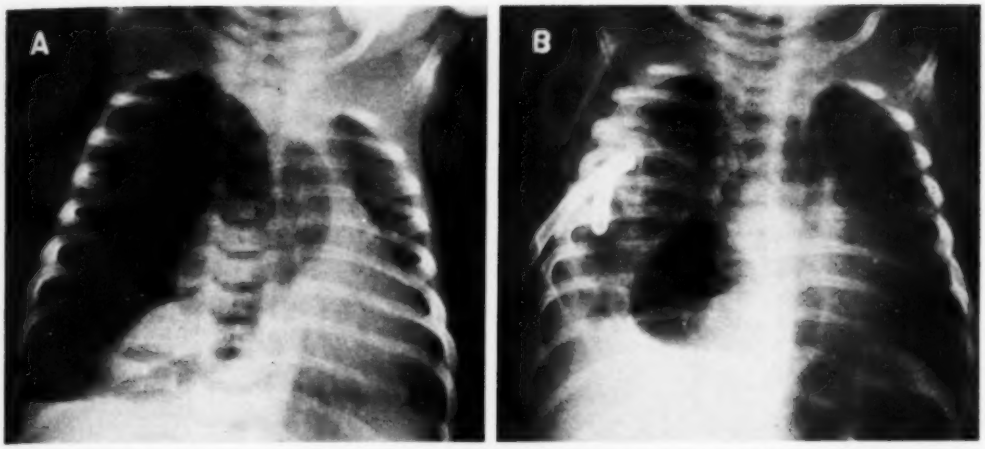

Fig. 8. Postinfectious pneumatocele complicated by tension pneumothorax. A. Massive tension pneumothorax was present on admission. B. When the pneumothorax is relieved and normal anatomical landmarks are restored, a consolidated lobe and pneumatocele are clearly visible.

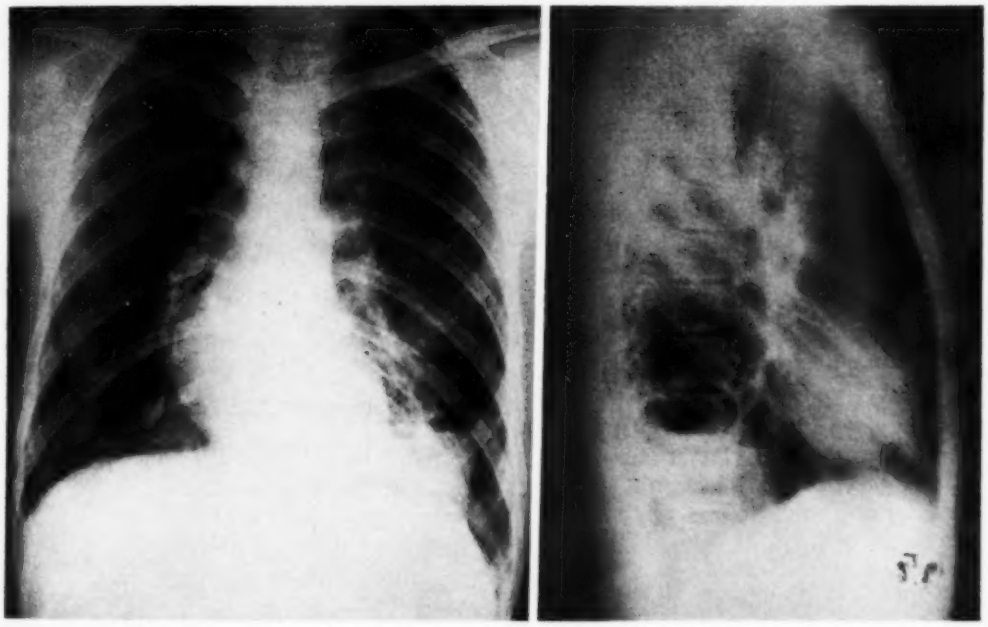

Fig. 9. Sequestration of the lung in the left base. This condition may remain silent until complicated by infection, at which time an area of consolidation occurs. One or more tension cysts may appear within it, and these have a tendency to progressive expansion.

With siphon drainage, the underlying lung re-expands, and other pneumatocele cavities surrounded by a wide margin of infected lung tissue may be detected (Fig. 8). Medical management should then be followed, and recourse to lobectomy or pneumonectomy avoided.

In the basilar portions of the lung, pneumatoceles must be differentiated from emphysematous bullae, sequestration of lung, and diaphragmatic hernia.

Sequestration of the lung may remain roentgenologically obscure until complicated by infection, when its configuration

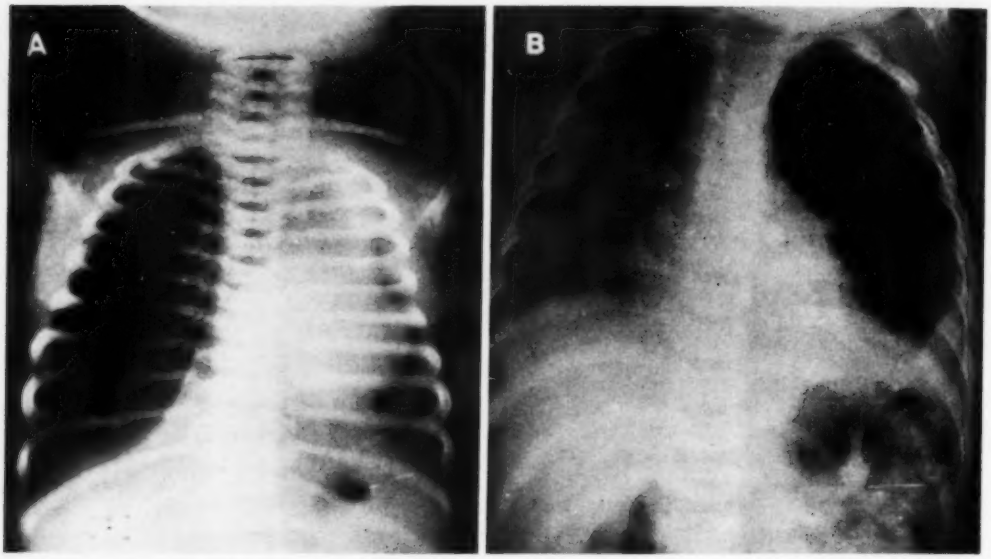

Fig. 10. Communicating type of cystic hamartoma *versus* obstructive emphysema due to foreign body. In hyperplasia of the lung with bronchial communication, a diffuse area of hyperventilation occurs (A) which is virtually impossible to distinguish from obstructive emphysema due to foreign body or a bronchostenotic lesion(B). Occurrence of hamartomas in newborn and premature infants, without history of aspiration or infection is an aid in differentiation. (Compare with Fig. 2.)

is manifest by the presence of pneumonic consolidation. An oval area of increased density in the posterior basilar lung segment with a finger-like extension from its inferior border passing into the upper diaphragmatic surface is characteristic. At this time, one or more tension cysts may appear within it (Fig. 9). The tendency for progressive expansion of these cysts with repeated infection makes surgical removal of this type of lesion desirable.

Some cases of sequestration and solitary cyst can be recognized by planigraphy or bronchography. This depends upon demonstration of the actual stenosis or absence of the portion of the bronchus proximal to the cyst.

Unilateral Diffuse Rarefactions: This type of tension state is produced by the congenital cystic hamartomas and the acquired obstructive emphysemas. In cystic hamartomas, the bronchial supply leading to the involved portion is undersized in proportion to the mass of hyperplastic lung tissue present. If this malformation communicates with the bronchial tree, it appears as a diffuse hyperventilated area of increased radiability. This can be distinguished from emphysematous bullae by its poorly defined margins, but the roentgen findings may closely resemble those of obstructive emphysema due to bronchostenotic lesions or foreign body (Fig. 10). The hamartomatous bronchial mass at the hilus, the lack of uniform radiolucency, and the severe mediastinal displacement without hernia occurring in a newborn or premature infant should suggest the diagnosis in most cases. Usually there is no formation of large air cysts, because the check-valve mechanism occurs in the larger bronchi.

Bilateral Diffuse Rarefactions: The third group of pulmonary tension lesions are produced by congenital cystic bronchiectasis, honeycombed lung, and the asthmatic forms of emphysema. In croupous tracheobronchitis of infancy, there is also a severe bilateral obstructive emphysema which produces markedly increased radiability of both lungs, with splintered areas of atelectasis interposed. Unless there is a complicating infection, the plain film findings are similar in these conditions.

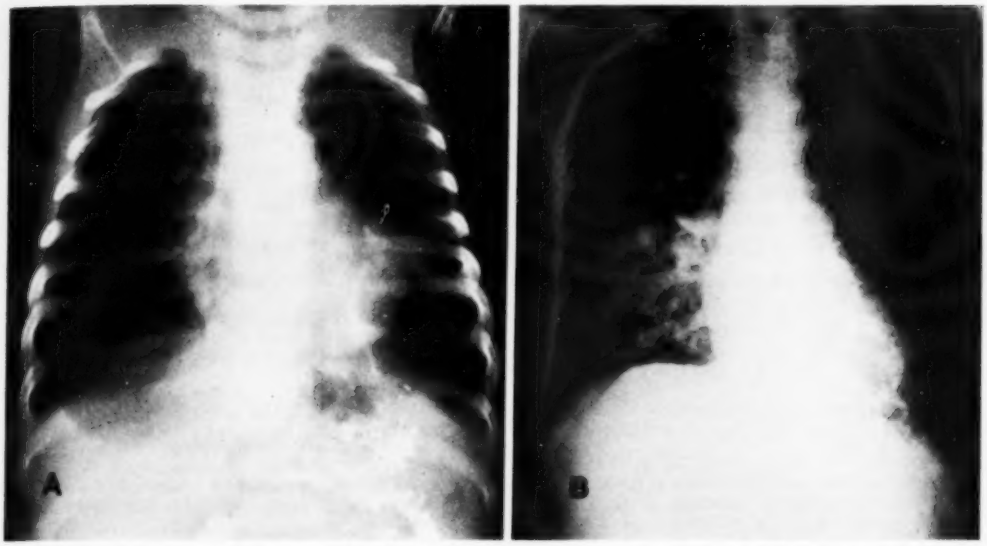

Fig. 11. Honeycomb lungs. A. Extensive bilateral fibrocystic emphysema occurring in honeycomb lung in infancy before severe infection has occurred. The plain film findings of the congenital and acquired types are indistinguishable. B. At a later age honeycomb lungs are complicated by infection, as shown in this case. There are confluent areas of pneumonic density and interstitial scarring. The multiple cystic cavities enlarge and diffuse areas of greater rarefaction develop.

Congenital honeycombed lungs are usually discovered accidentally by x-ray unless complicated by infection. Extensive cystic changes throughout both lungs of a male infant with a paucity of clinical symptoms should suggest the congenital type of this lesion. The acquired form of honeycombed lungs, or fibrocystic disease, occurs at an older age and usually shows considerably more interstitial fibrotic density with multiple overlapping small areas of rarefaction. Once infection occurs, the plain film findings of both types of honeycombed lungs and cystic bronchiectasis are indistinguishable. With repeated infections, both show formation of conglomerate areas of bronchopneumonia, interstitial scarring, and pleural thickening (Fig. 11). The cystic cavities become confluent and enlarged, and localized areas of greater rarefaction are commonly seen in different portions of the lung.

Bronchography is useful in differentiating this group. In pulmonary emphysema, the bronchial pathways are distorted and their patency is reduced, whereas in cystic bronchiectasis numerous tiny cystic cavities are visualized throughout the involved lobes. Honeycombed lung, on the other hand, shows a failure of the oil to enter the cystic cavities, with a resultant distorted pattern in the terminal arborizations.

SUMMARY AND CONCLUSIONS

The primary causes of pulmonary tension rarefactions in the lungs of infants and children are congenital bronchial malformations and acquired interstitial and pleural air cysts. In both groups tension states develop as a result of check-valve mechanisms between the distended cavity and its air supply.

Differentiation of the acquired from the congenital forms is important to prognosis and treatment, and this is best accomplished by careful correlation of the roentgen and clinical findings. Serial chest roentgenograms are the most important single aid in differential diagnosis. Occasionally bronchography and planigraphy will make possible recognition of these lesions.

In the congenital group, complete surgi-

cal removal is the only definitive treatment for all but the generalized forms, while the acquired lesions are best treated conservatively. Accurate roentgenological differentiation of various tension disorders is sometimes impossible, but a system of analysis is presented which should allow separation of the surgical from the nonsurgical types.

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SUMARIO

Diferenciación Roentgenológica de los Trastornos de la Tensión Pulmonar en los Lactantes y los Niños Mayores

Las causas primarias de las rarefacciones de la tensión pulmonar en los lactantes y en los niños mayores consisten en deformidades congénitas de los bronquios y en quistes gaseosos intersticiales y pleurales adquiridos. En ambos grupos, aparecen estados de tensión a consecuencia de mecanismos de válvula de retención entre la cavidad distendida y su abasto de aire.

La diferenciación de las formas adquiridas, de las congénitas, es importante para el pronóstico y el tratamiento, lo cual se hace mejor correlacionando cuidadosamente los hallazgos roentgenológicos y los clínicos. Las radiografías torácicas en serie constituyen el auxiliar más importante en el diagnóstico diferencial. De vez en cuando la broncografía y la planigrafía permiten reconocer esas lesiones.

En el grupo congénito, la extirpación quirúrgica total representa el único tratamiento definitivo para todas las formas, aparte de las generalizadas, en tanto que es mejor tratar conservadoramente las lesiones adquiridas. La diferenciación roentgenológica exacta de varios trastornos de la tensión resulta algunas veces imposible, pero ofrécese un sistema de análisis que debe permitir la separación de las formas quirúrgicas, de aquéllas en que no está indicada la operación.

DISCUSSION

William A. Evans, Jr., M.D. (Detroit, Mich.): Doctor Campbell has brought together a group of conditions having some common features, but differing in pathogenesis, which is of much interest to pediatric radiologists. I would infer that he, too, has his difficulties with nomenclature, but we have made much progress since the discussions of the early roentgenologists concerning "annular shadows" in the chest. While we may still quibble over terminology and pathogenesis, our present understanding does offer a reliable guide to treatment, and the development of surgical technics in recent years has vastly expanded our scope of management. As Doctor Campbell has indicated, the nature of these lesions usually becomes apparent as their behavior is observed over a period of time, and that, I would agree, is most important in diagnosis. It seems hardly necessary to mention that the roentgenograms even in the smallest subjects can and should be made with the patient in the upright position for the detection of fluid levels, and in sagittal and lateral projections, but my experience indicates that these technics are still not as generally practised as they should be.

Roentgenologic Considerations in the Diagnosis of Congenital Tricuspid Atresia[1]

SUMNER N. MARDER, M.D.[2], WILLIAM B. SEAMAN, M.D., and WENDELL G. SCOTT, M.D.

CONGENITAL tricuspid atresia is a complex congenital malformation manifested in a variety of forms. As Edwards and Burchell (8) point out, certain features are common to all cases: (1) atresia of the tricuspid valve, (2) atrial septal defect, (3) a large mitral orifice, and (4) hypoplasia of the right ventricle. Thus the venous return from the systemic circulation flows from the right auricle *via* the atrial septal defect to the left auricle, where it mixes with arterialized blood entering the left atrium through the pulmonary veins. It then enters the left ventricle, which functions as a single ventricle.

Since the left ventricle expels blood into both the pulmonary artery and the aorta, cases of tricuspid atresia may be further subdivided according to the manner in which the blood is distributed through them to the two circulations. The traditional criteria for this subdivision have been the absence or presence of transposition of the great vessels and/or pulmonic stenosis. Thus, in Group I-*a* of Edwards and Burchell's classification are found those cases in which there is no transposition of the great vessels, the ventricular septum is intact, and the blood reaches the lungs *via* the aorta and a patent ductus arteriosus. In their second subgroup (I-*b*) transposition is also absent, and the blood flows through an interventricular septal defect and a hypoplastic right ventricular chamber to reach the lungs. Some degree of pulmonic or subpulmonic stenosis is usually present in this group. In the remaining cases transposition of the great vessels is present and the two ventricles communicate with each other so that they function as a single chamber. The chief difference between these subgroups (II-*a* and II-*b*) is that the former is associated with pulmonic or subpulmonic stenosis.

It follows from these pathologic considerations that one of the most critical factors is the volume of blood reaching the pulmonary circulation. This depends on the presence and degree of pulmonic stenosis and the size of the patent ductus arteriosus. Since the left ventricle communicates with both the aorta and pulmonary artery in all instances, the presence or absence of transposition is physiologically unimportant. Of more importance is the size of the atrial septal defect, since this determines the volume of the systemic venous return and therefore of the cardiac output (15).

Roentgenologic studies from 8 cases of congenital tricuspid atresia have been reviewed in order to evaluate their contributions to the diagnosis of this malformation. The presence of pulmonic stenosis can be frequently detected on conventional roentgenograms, and this method is of considerable value in the selection of patients for operation. Angiography, on the other hand, is essential for the diagnosis of the fundamental malformation, although it may also be helpful in selecting the type of surgical procedure to be employed.

CONVENTIONAL ROENTGENOGRAPHY

The most important information to be obtained from the conventional roentgenograms is provided by the intrapulmonary branches of the pulmonary artery. Since the caliber of these vessels may reflect blood flow and/or pressure within them (9), it is frequently possible to make an unequivocal statement as to the presence or absence of pulmonic stenosis. This is of particular importance when it is realized that cardiac catheterization and angio-

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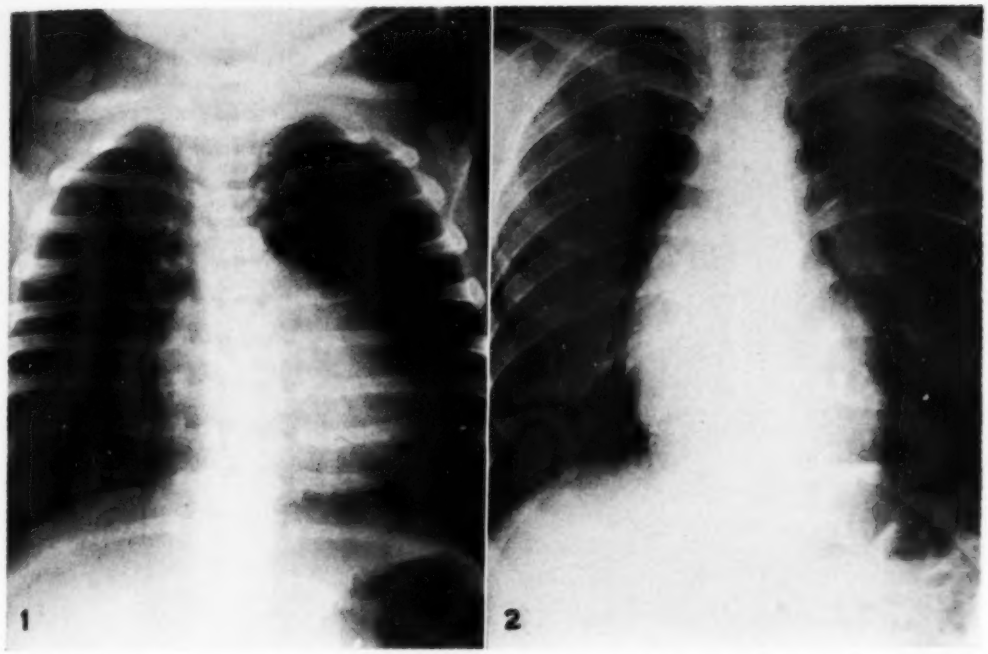

Fig. 1. Case I. Tricuspid atresia with right aortic arch and descending aorta, pulmonary stenosis, large left ventricle and right auricle (autopsy proved). Clear lung fields denote the presence of pulmonary stenosis.
Fig. 2. Case II. Tricuspid atresia with numerous collateral vessels in the hilar area noted during surgery. Pulmonary vascular markings are numerous but small in caliber and lack the normal distribution.

cardiography may be of limited value in this regard in the malformation under discussion.

As pointed out by Campbell and Gardner (6), extensive bronchial collateral circulation may obscure somewhat the characteristic picture of "pulmonary ischemia," especially in patients surviving to an older age, so that it is not sufficient merely to look for clear lung fields. The number, distribution, and especially the caliber of the vascular shadows in the midportions of the lung fields must be carefully evaluated. The roentgenograms of Case I (Fig. 1) illustrate the characteristic pattern in a younger child and may be contrasted with those of Case II (Fig. 2), in a 14-year-old boy with extensive collateral circulation as confirmed at operation.

In the occasional case of tricuspid atresia without pulmonic stenosis, the pulmonary artery shadows may be enlarged and show increased pulsations at fluoroscopy. These cases are ordinarily associated with transposition of the great vessels and a high interventricular septal defect. Thus they represent a form of the "double outlet ventricle," and one would anticipate a high pulmonary blood flow and pressure (13). Figure 3 (Case III) represents the only proved case of this type in the present series. The cardiac contour is not characteristic; but the engorged pulmonary arteries are clear evidence against a diagnosis of pulmonic stenosis.

In previous studies of congenital tricuspid atresia, aortic arch anomalies have been extremely uncommon, in contrast to the tetralogy of Fallot, in which the incidence of a right aortic arch is approximately 20 to 25 per cent (8). However, Wittenborg *et al.* (16) have recently reported 2 cases of tricuspid atresia with a right-sided aortic arch and 1 such case occurred among the 3 autopsied cases of the present series (Case I, Fig. 1). Therefore, a right aortic arch, while probably favoring the diagnosis of tetralogy of Fallot, does not exclude the

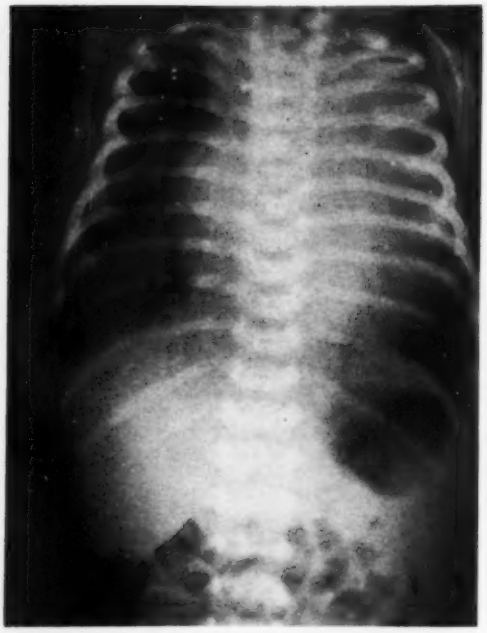

Fig. 3. Case III. Tricuspid atresia with transposition of the great vessels, atrial and ventricular septal defects, and patent ductus arteriosus (autopsy proved). The large pulmonary vascular shadows exclude the presence of pulmonic stenosis.

possibility of congenital tricuspid atresia.

We are able to confirm the statement of Wittenborg and his associates that the cardiac silhouette rarely permits differentiation between tricuspid atresia and the tetralogy of Fallot. These authors have presented an excellent description of the "characteristic" configuration, as well as an ingenious explanation for its uncommon occurrence. The classical description of the cardiac contour is largely based on a deficiency of the lower half of the right heart border in the postero-anterior and left anterior oblique views (Case IV, Fig. 4). However, if the size of the defect in the atrial septum is small relative to the size of the mitral orifice, the right auricle may become dilated and/or hypertrophied. When this occurs, the lower half of the right cardiac contour is full and the "characteristic" contour is absent. Right auricular hypertrophy and dilatation were noted in 2 of the autopsied cases of this series (Cases I and VII).

ANGIOCARDIOGRAPHY

Contrast visualization will usually reveal diversion of systemic venous return to the left side of the heart and thus indicate the tricuspid valvular lesion. This diagnosis, then, depends simply on the sequential opacification of the right auricle, left auricle, and left ventricle. (Figs. 5–8). Some difficulty may be encountered in differentiating this malformation from other forms of single ventricle. In most instances of tricuspid atresia, it will be apparent that the ventricle fills from the left auricle. A helpful sign has been a triangular non-opacified area at the diaphragmatic surface of the heart in the region occupied by the right ventricle. The other two sides of this triangle are formed by the right auricle and left ventricle. In our experience, all of these features are best shown in the anteroposterior projection, (Fig. 5), which avoids the overlap and superimposition of chambers encountered in the oblique view (Fig. 8).

The malformations of the outflow tract are complex, multiple, and confined to a limited anatomic area at the base of the heart. The pulmonary outflow tract is frequently formed by the interventricular septal defect and the small right ventricular chamber. Obstruction to pulmonary outflow may result from the small size of these structures in addition to muscular and fibrous ridges in the subvalvular region (8). These pathologic features are difficult to demonstrate radiologically, although we have not tried the right anterior oblique projection, which has been effective in demonstrating subpulmonic stenosis in the tetralogy of Fallot (12). The pulmonic (actually subpulmonic) stenosis was not directly visualized in any of our cases. Several indirect criteria of pulmonary stenosis have been proposed in the past: (1) slow "clearance" or delayed appearance of contrast material in the pulmonary circuit, (2) the caliber of the opacified pulmonary arteries, (3) non-opacification of the pulmonary arteries.

In evaluating the caliber of the opacified pulmonary arteries as shown on angio-

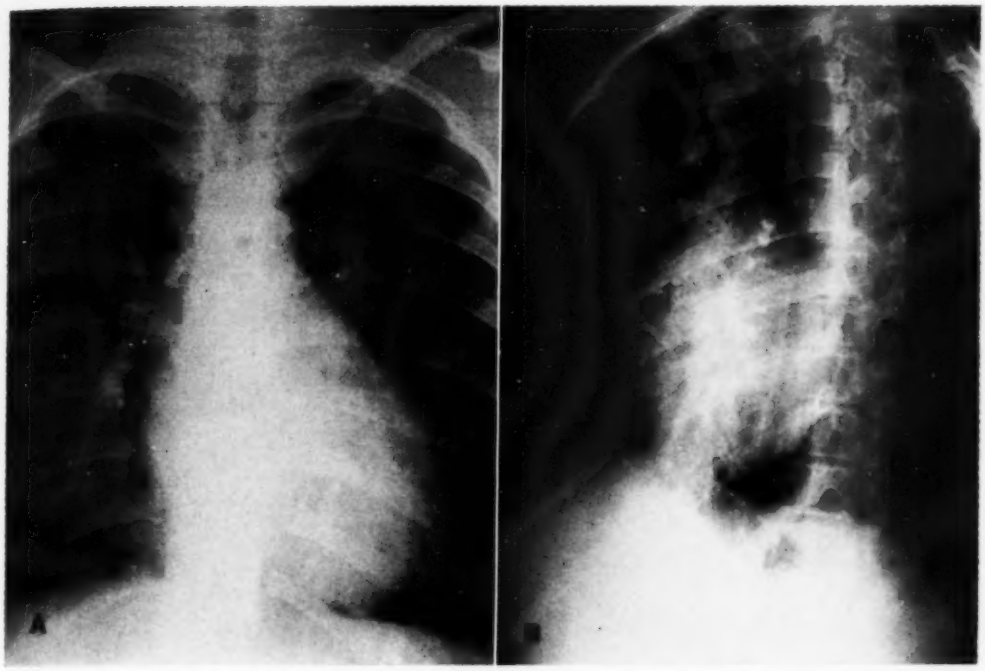

Fig. 4. Case IV. A. "Characteristic" contour of tricuspid atresia in the postero-anterior projection, with flattening of the lower half of the right heart border. B. Left anterior oblique projection. "Characteristic" silhouette of tricuspid atresia with flattening of the lower anterior portion of the cardiac contour.

grams, one must exercise great caution to consider carefully the influence of variations in technical factors such as the volume and speed of the injection and the exposure of the films. The use of short target-film distances produces considerable magnification, which may result in making small vessels appear of normal caliber. It is our opinion that the indirect criteria are of limited value and frequently difficult to interpret objectively. In this case one may obtain more reliable information from the reduced caliber of the pulmonary vessels as seen on conventional radiographs for the diagnosis of pulmonic stenosis.

While it has been suggested (3, 7) that transposition of the great vessels may be suspected on the postero-anterior angiocardiogram, our experience coincides with that of Abrams *et al.* (1), that the course of the aorta and its relation to the pulmonary artery at the origin of the two vessels can be best evaluated in the lateral view (Case IV, Fig. 6).

This interpretation of the angiocardiographic findings does not differ essentially from that reported by Cooley *et al.* (7), but their classification, based on transposition of vessels and non-visualization of the right ventricle, in our experience has not proved clinically helpful.

CLINICAL ABSTRACTS

CASE I: B. L. R., a 3 1/2-month-old white female, had been cyanotic since birth. A harsh systolic murmur was heard over the entire precordium. There was electrocardiographic evidence of left ventricular hypertrophy. Chest films showed an enlarged heart with a right aortic arch and "clear" lung fields, denoting pulmonic stenosis (Fig. 1).

At autopsy the heart was found to be twice the usual size, with hypertrophy of the left ventricle and right auricle and a hypoplastic right ventricle. There were two defects in the atrial septum and one in the mid-portion of the interventricular septum. The tricuspid valve was atretic. A stenosis of the subpulmonic area was demonstrated, with a bicuspid pulmonic valve and hypoplasia of the pulmonary artery. The aortic arch and descending aorta were on the right side, but there was no evidence of transposition of the great vessels.

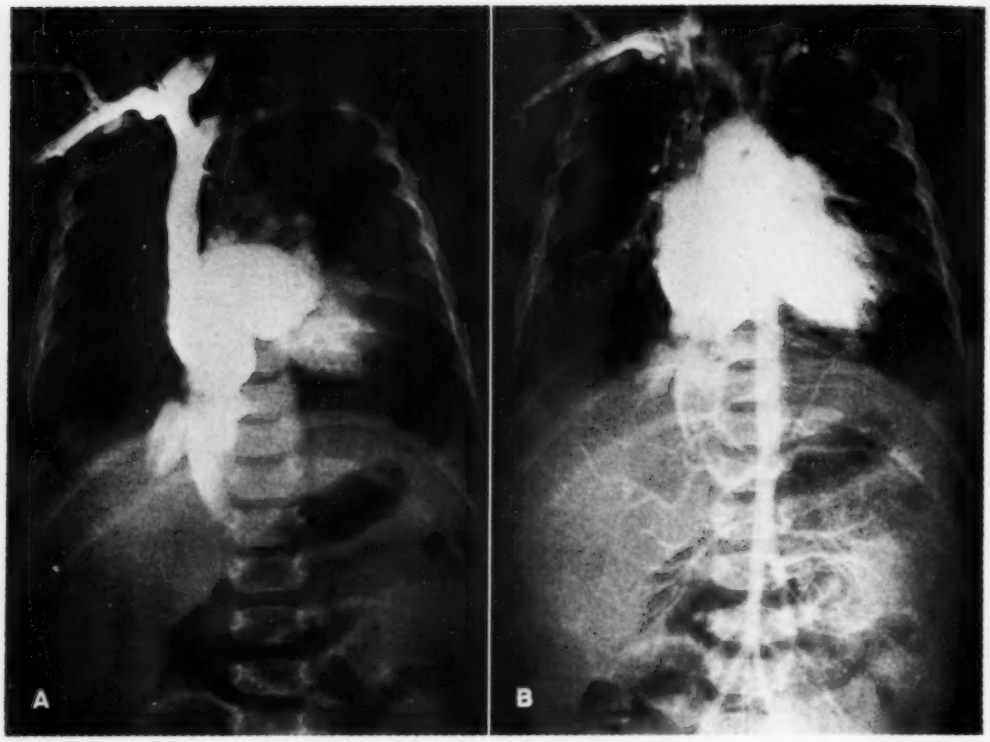

Fig. 5. Case V. Cyanotic infant with polycythemia and left axis deviation. A. Angiocardiogram in postero-anterior projection showing opacification of right auricle and left auricle, with beginning flow into the left ventricle. Note the triangular area of non-opacification at the diaphragmatic surface of the heart in the region occupied by the right ventricle. B. Complete visualization of right auricle, left auricle, left ventricle, pulmonary arterial tree, and aorta.

CASE II: C. T., a 13-year-old boy, had been considered normal until the age of five years, when cyanosis was first detected. Subsequently, dyspnea, palpitation, and clubbing of fingers and toes developed, with marked limitation of physical activity.

Physical examination, except for the clubbing and cyanosis, revealed only a Grade II systolic precordial murmur. The electrocardiogram showed an abnormal pattern and a prolonged conduction time without evidence of axis deviation.

Chest roentgenograms disclosed a slightly enlarged heart. The pulmonary vascular shadows were numerous but tortuous and of small caliber, and this was interpreted as evidence of pulmonic stenosis with development of a bronchial collateral circulation (Fig. 2). Angiocardiograms were diagnostic of tricuspid atresia.

At operation the pulmonary artery showed markedly reduced pulsations, and numerous bronchial collateral vessels were observed in the hilar regions. A Potts-Smith anastomosis was performed with considerable subsequent improvement.

CASE III: R. E. H., a white male infant, was referred to the hospital because of cyanotic episodes. Examination disclosed minimal cyanosis at rest and a Grade II systolic murmur. Femoral pulsations were absent, and no blood pressure reading could be obtained in the lower extremities, although in the arms it was 150/100. An electrocardiogram showed evidence of left axis deviation. Moderate polycythemia was present, with 18 gm. hemoglobin.

Roentgen examination of the chest disclosed cardiac enlargement and large pulmonary vascular shadows that excluded the presence of pulmonic stenosis (Fig. 3).

At autopsy, atresia of the tricuspid valve was found, with a hypoplastic right ventricle and a greatly enlarged left ventricle. There were defects in both the atrial and ventricular septa, as well as transposition of the great vessels and preductile coarctation of the aorta associated with a large patent ductus arteriosus.

CASE IV: P. A., a 13-year-old white girl, had been cyanotic since the age of seven months. Clubbed fingers and squatting had also been noted for an indefinite period of time. Physical examination revealed a loud systolic murmur and a palpable thrill over the left third intercostal space. Polycythemia

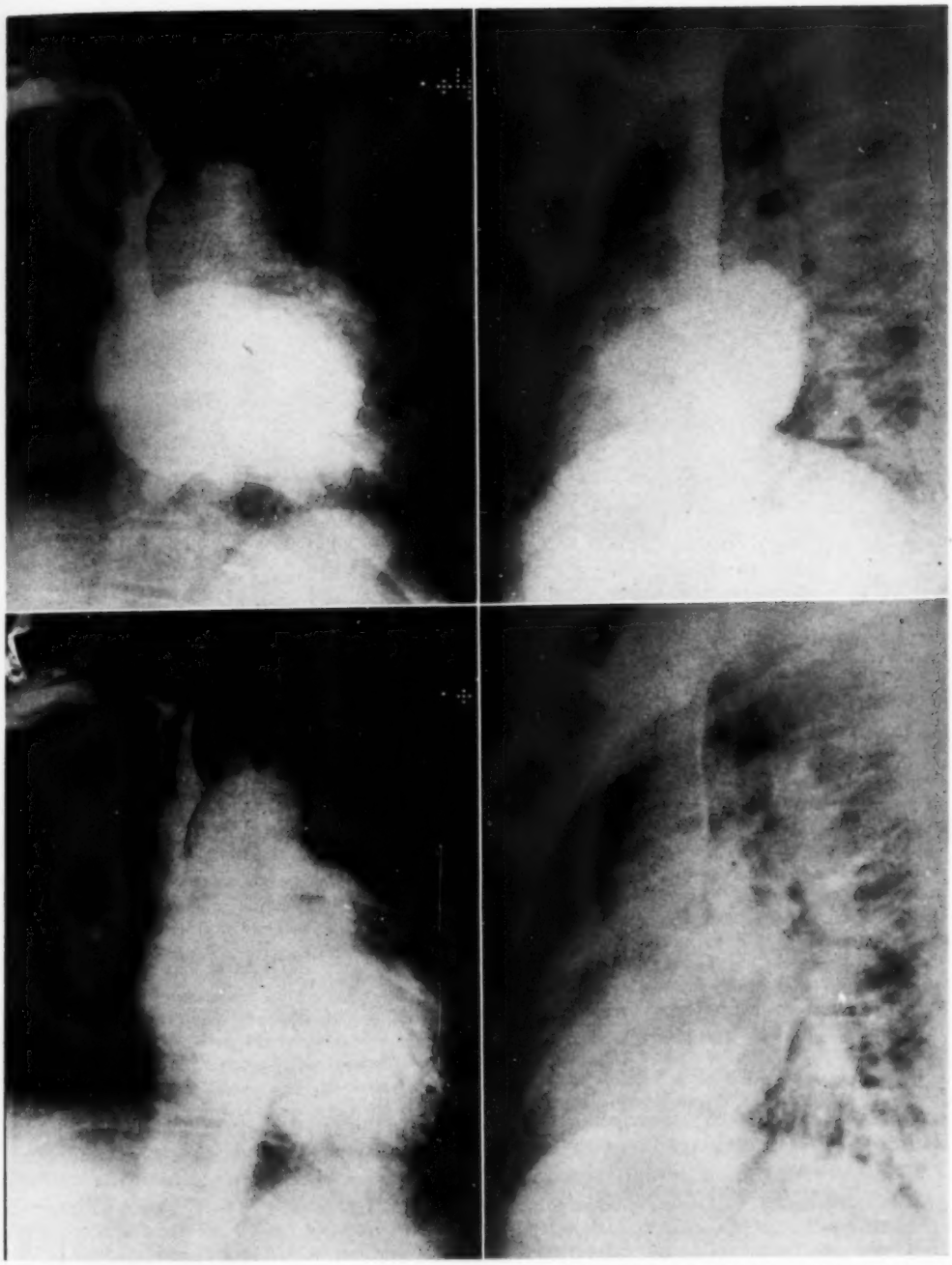

Fig. 6. Biplane angiocardiograms of Case IV, showing sequential opacification of right and left auricle and triangular area of non-opacification in the region of the right ventricle, with subsequent simultaneous filling of aorta and pulmonary artery.

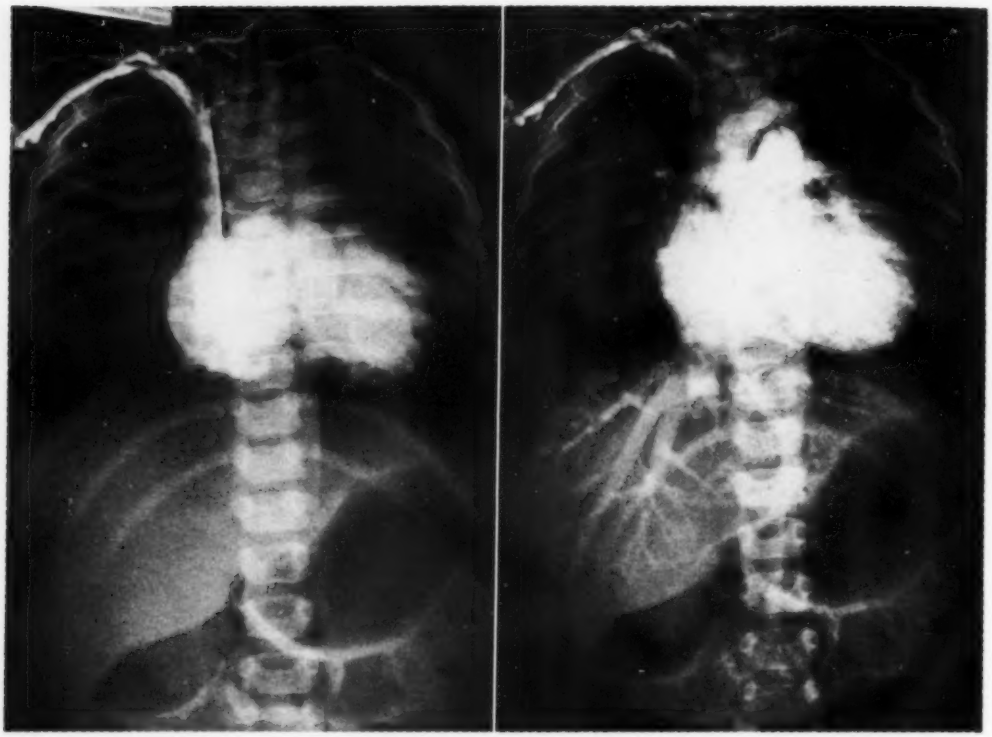

Fig. 7. Case VI. Characteristic angiocardiographic findings of tricuspid atresia in a cyanotic infant with left axis deviation.

and electrocardiographic evidence of left ventricular hypertrophy were also discovered.

Cardiac catheterization was not helpful, since the pulmonary artery could not be entered. Conventional roentgenograms exhibited the characteristic contour of tricuspid atresia, with flattening of the lower half of the right heart border in the posteroanterior projection and of the anterior portion of the cardiac silhouette in the left anterior oblique view (Fig. 4). Angiocardiography was carried out in the anteroposterior and lateral positions, with the biplane angiocardiographic unit, and the characteristic findings of tricuspid atresia were demonstrated (Fig. 6). At operation, the pulmonary artery was found to be small and collapsible. A Potts-Smith anastomosis was performed, with immediate improvement in color.

CASE V: G. B., a 4-month-old white male infant, had been blue since birth. Examination of the heart was not remarkable. Laboratory findings included polycythemia and left axis deviation (standard leads). Conventional chest films showed a heart of normal size and shape, although the "clear" lung fields suggested the presence of pulmonic stenosis. Angiocardiograms were diagnostic of tricuspid atresia (Fig. 5). The infant died while being prepared for surgery, and autopsy permission was not obtained.

CASE VI: R. D., an 8-month-old white male, had been cyanotic since birth. Physical examination revealed a Grade II systolic murmur associated with a palpable thrill over the third left intercostal space. Electrocardiograms were interpreted as showing left axis deviation. Roentgenograms of the chest disclosed a globular heart, moderately enlarged. The presence of pulmonic stenosis was denoted by the diminished caliber of the pulmonary vascular shadows. The angiocardiograms were considered to be characteristic of tricuspid atresia (Fig. 7). At operation, the pulmonary arteries were found to be reduced in caliber and showed diminished pulsations. An aortico-pulmonary anastomosis was performed, with considerable improvement.

CASE VII: J. W. L. Although normal at birth, this 21-month-old white male was found to have a heart murmur at one month and cyanosis by the age of eleven months. Examination disclosed a harsh systolic apical murmur and a liver palpable five fingerbreadths below the costal margin. Polycythemia and left axis deviation were present. Angiocardiography revealed the characteristic findings of tricuspid atresia.

Two operations were performed, but the small caliber of the pulmonary arteries did not permit creation of an anastomosis. The child died of a cerebral thrombosis following the second operation.

At autopsy, atresia of the tricuspid valve was found. The right ventricle was hypoplastic, while the left ventricle and right auricle were markedly hypertrophied. A partially guarded patent foramen ovale and a defect in the mid-portion of the ventricular septum were present. Subpulmonic stenosis was found, although the great vessels were in their normal relationship and the ductus arteriosus was closed.

CASE VIII: K. D., a 3-year-old white female, had been cyanotic since birth. In addition to cyanosis and clubbing, the physical examination revealed a Grade IV systolic murmur and minimal hepatomegaly. Polycythemia was present. Electrocardiograms revealed left axis deviation.

Chest roentgenograms disclosed a moderately enlarged globular heart. Because the caliber of the pulmonary vessels was smaller than normal, pulmonic stenosis was thought to be present. The angiocardiogram was characteristic of tricuspid atresia (Fig. 8). A Potts-Smith anastomosis was carried out, with considerable improvement in color.

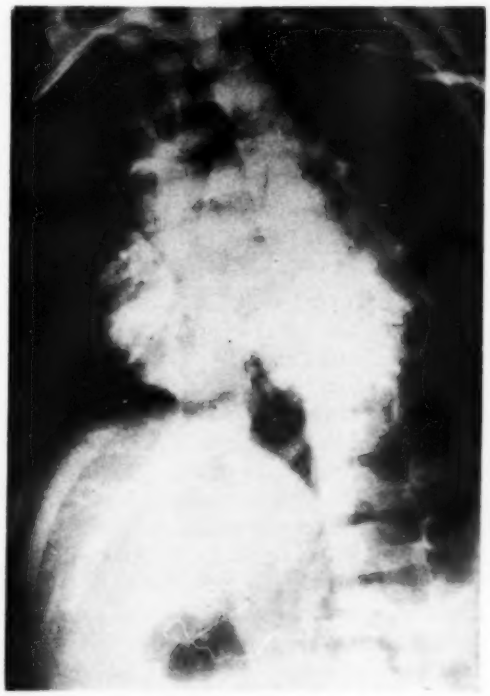

Fig. 8. Case VIII. Three-year-old cyanotic infant with left axis deviation and systolic murmur. Angiocardiogram in the right posterior oblique projection demonstrating the characteristic features of tricuspid atresia.

DISCUSSION

Clinically, two major diagnostic problems are presented by cases of tricuspid atresia: detection of the basic malformation and the recognition of cases with pulmonic stenosis. Prior to the introduction of infundibular and valvular resection by Brock (5), the secondary diagnosis of pulmonic stenosis was of greater significance than that of the basic malformation. Patients with pulmonic stenosis and chronic cyanosis might be benefited by aortico-pulmonary anastomosis, and differentiation between various pathological entities was not of practical import.

With two types of procedure at his command, the surgeon may now desire further diagnostic information preoperatively. From the nature of the pathological anatomy of the pulmonic stenosis in case of tricuspid atresia (8), one would anticipate, and indeed Brock (4) has recently stated, that an aortico-pulmonary anastomosis is still the procedure of choice.

There is still another reason for believing that a more complete diagnosis may be required or desirable in the near future. Several authors have discussed the disabling effects of a small interauricular septal defect (10, 15, 16), and this is illustrated in two cases of this series. Blalock and Hanlon (2) have demonstrated the feasibility of enlarging an atrial septal defect and creating a systemic-pulmonary shunt in a one-stage procedure when the clinical examination reveals hepatic enlargement and venous congestion and the radiographs show dilatation of the right auricle. An exact anatomical diagnosis may be desirable prior to this complex surgical undertaking.

In clinical practice, congenital tricuspid atresia will ordinarily be differentiated from other anomalies presenting chronic cyanosis and pulmonic stenosis by the electrocardiographic findings of left axis deviation or left ventricular hypertrophy. The limitations of this sign, however, are now being recognized (11, 14), and cases will be encountered in which the simple

clinical procedures will not suffice for diagnosis. These cases and the desire for more precise anatomical data will constitute the indications for angiocardiography.

SUMMARY

It is suggested that the cardiac anomalies associated with congenital tricuspid atresia be divided into two groups for clinical purposes: those associated with the fundamental valvular lesion (atrial septal defect and hypoplasia of the right ventricle) and those involving the outflow tract of the left ventricle, of which pulmonic stenosis is the most important.

Review of the roentgenological examinations in 8 cases suggests: (1) that the fundamental lesion is rarely detectable on conventional roentgenograms alone, but may be diagnosed on the basis of a consistent angiocardiographic appearance which indicates sequential opacification of the right auricle, left auricle, and left ventricle; (2) that pulmonic stenosis may be diagnosed by careful evaluation of the plain films for reduction in the caliber of the intrapulmonary branches of the pulmonary arteries and/or evidence of bronchial collateral circulation.

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SUMARIO

Consideraciones Roentgenológicas en el Diagnóstico de la Atresia Congénita de la Tricúspide

Sugiérese que, para fines clínicos, se dividan las anomalías cardíacas asociadas con la atresia congénita de la tricúspide en dos grupos: las enlazadas con la lesión valvular fundamental y las que afectan el trayecto de salida del ventrículo izquierdo, de las cuales la estenosis de la válvula pulmonar es la más importante.

El repaso de los exámenes roentgenológicos en 8 casos sugiere que: (1) puede diagnosticarse a base de un constante aspecto angiocardiográfico que indica opacidad sucesiva de la aurícula derecha, la aurícula izquierda y del ventrículo izquierdo; (2) puede diagnosticarse la estenosis de la válvula pulmonar, buscando cuidadosamente en las radiografías simples toda reducción del calibre de las ramas intrapulmonares de las arterias pulmonares y/o signos de circulación colateral bronquial.

Lateral Views of the Segmental Bronchi and Related Pulmonary Vessels in an Injected Preparation of the Lungs[1]

EDWARD A. BOYDEN, PH.D. (MED. SC.)

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LATERAL bronchograms are now one of the accepted means of identifying segmental bronchi. For the most part these are clearly understood but, until recently, little attention has been paid to the identification of subsegmental rami. Yet these are the units which most frequently shift their position on the bronchial tree. So common is this shifting of parts that virtually every pair of lungs is characterized by numerous deviations from the so-called "normal." Even less familiar is the position of the chief pulmonary vessels in lateral projections of the lungs.

To illustrate some of these points, it has seemed worth while to present lateral views of a perfectly injected (and therefore inflated) pair of lungs—specimens which offer close approximation to the living structures. These lateral views have been supplemented by sketches of mediastinal and diaphragmatic surfaces, so that from one aspect or another all parts of a single specimen may be comprehended.

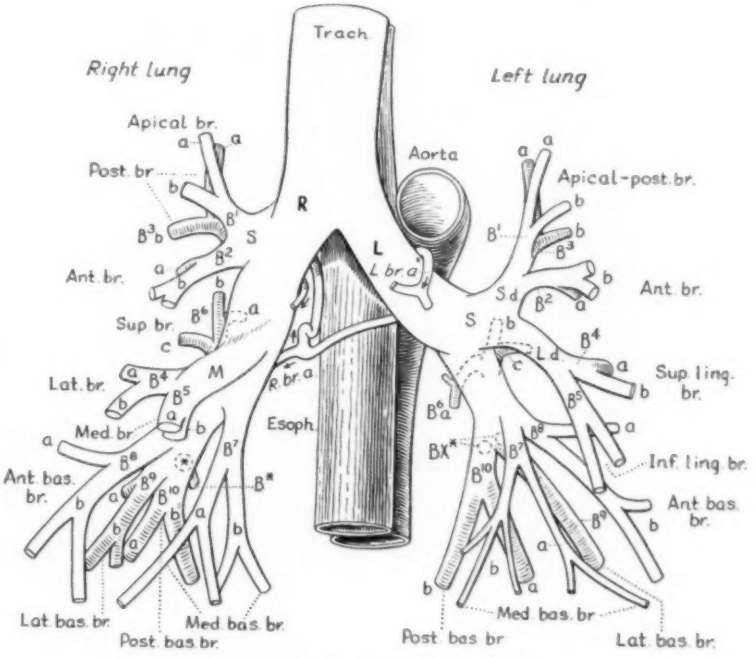

Fig. 1. Anterior View of Bronchial Tree.
From Boyden: Dis. of Chest 15: 657, 1949.

The opportunity to make such a study was generously provided by Professor Averill A. Liebow of the Yale Department of Pathology, who sent to me one of his triply injected Vinylite specimens, in the preparation and use of which he has become

[1] From the Department of Anatomy, University of Minnesota. Aided by grants from the Medical Research Funds of the Graduate School. Accepted for publication in October 1952.

Plate I: Lateral View of Right Lung

Right Upper Lobe: The bronchi are colored black, the arteries red, and the veins blue. The upper lobe bronchus bifurcates into an apical-posterior (B^{1+3}) and an anterior trunk (B^2). This is an atypical arrangement, the prevailing pattern (38 per cent) being a trifurcation (B^1, B^2, B^3) (6). Clinically important subsegments are B^3a, B^3b, and B^2a, all three being sites of lung abscess; B^3a is also the site of Assmann's focus.

The arteries are atypical in that the blood supply of the upper lobe comes exclusively from the truncus anterior (see Plate IIIA) and not partly from the interlobar portion of the pulmonary artery. This arrangement has been found in 18 per cent of lungs (6).

With a few exceptions, the veins are normal. The posterior vein (V^2) is typically formed by the union of central (C) and interlobar (I) divisions, but its *d* branch, which separates anterior and posterior rami of B^2, is displaced, arising as VX^2d from the anterior vein (V^2, Plate IIIA).[2] Also V^2a courses lateral instead of medial to B^2a.

Middle Lobe: The bronchi are typical, and so are the arteries. Although there is only one middle lobe artery—two being equally common (5)—its branches follow the bronchial pattern. The veins are somewhat atypical, the most conspicuous variation being the presence of a superiorly placed V^4a2 which drains into V^2 (see VX^4a2, Plates I and IIIA). B^5 is not visible in this view.

Right Lower Lobe, Superior Segment (B^1): The three subsegmental bronchi arise from the stem bronchus as two separate trunks (B^6a + b and B^6c), one below the other. This variation has been found in 6 per cent of lungs, although the composition of the two trunks may vary (7). B^6a is medial and therefore hidden in a lateral view. Similarly, there are two separate arteries (A^6a + b and A^6c). Perhaps because of this spacing, V^6c (the vein that separates superior from basal segments) is smaller than usual.

Right Lower Lobe, Basal Segments (B^7 to B^{10}): A subsuperior bronchus is present (B^8) but no accessory subsuperior (BX^8). Lateral branches of the anterior basal and lateral basal bronchi (B^8a and B^9a) are conspicuous in the lateral view. The basal branches (B^8b and B^9b) are normal. The medial basal bronchus (B^7), which is hidden in this view, is atypical. (See description, Plate IVA.)

In general, basal arteries and veins follow the prevailing pattern. Note how the basal artery and its branches obscure the corresponding bronchi in a lateral view of the lower lobe.

[2] The interpolation of an X indicates that a given structure is displaced in origin.

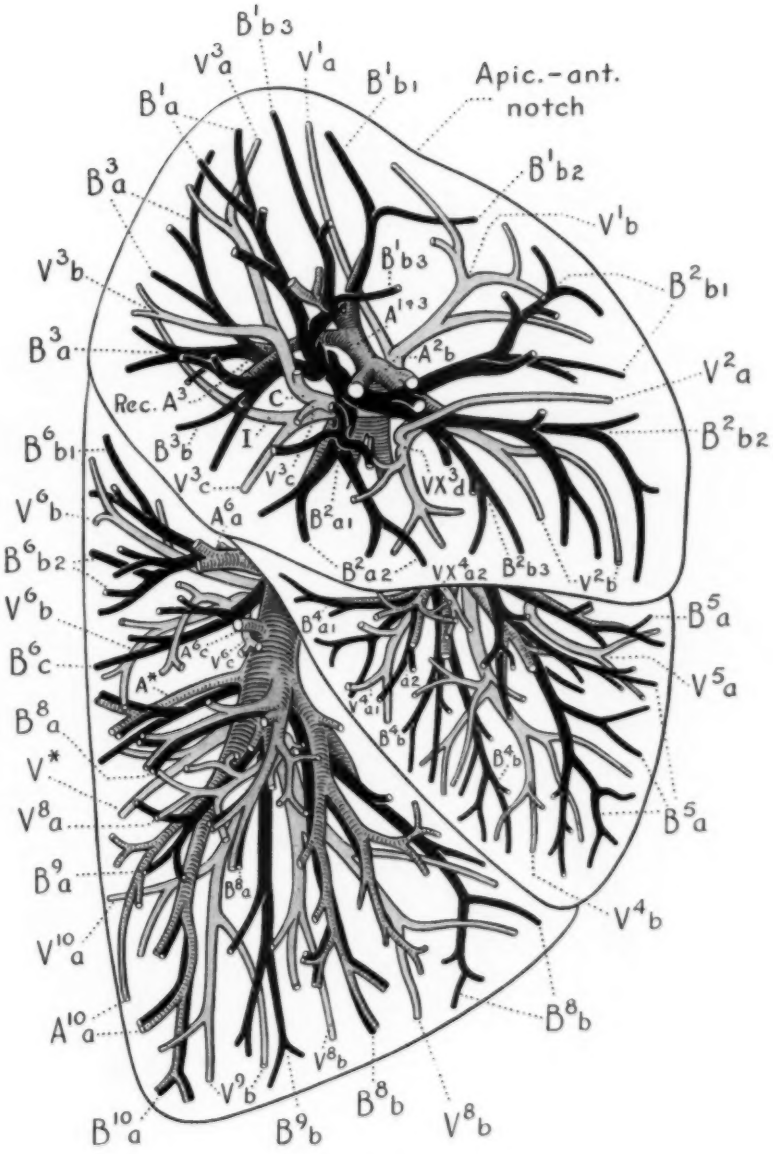
B'b3
V3a
V'a
B'b1
Apic.-ant. notch
B'a
B'b2
B3a
V'b
V3b
B'b3
B2b1
A1+3
B3a
A2b
V2a
Rec. A3
C
B2b2
B6b1
B3b
I
V3c
V3c
VX3d
B2a1
V6b
A6a
B6b2
B2a2
VX4a2
B2b3
V2b
V6b
B4a1
B5a
B6c
A6c
V6c
A*
V5a
a2
V4a1
B8a
B4b
V*
B4b
B5a
V8a
B9a
B8a
V4b
V10a
B8b
A10a
V8b
V9b
B8b
B10a
B9b
V8b

PLATE I

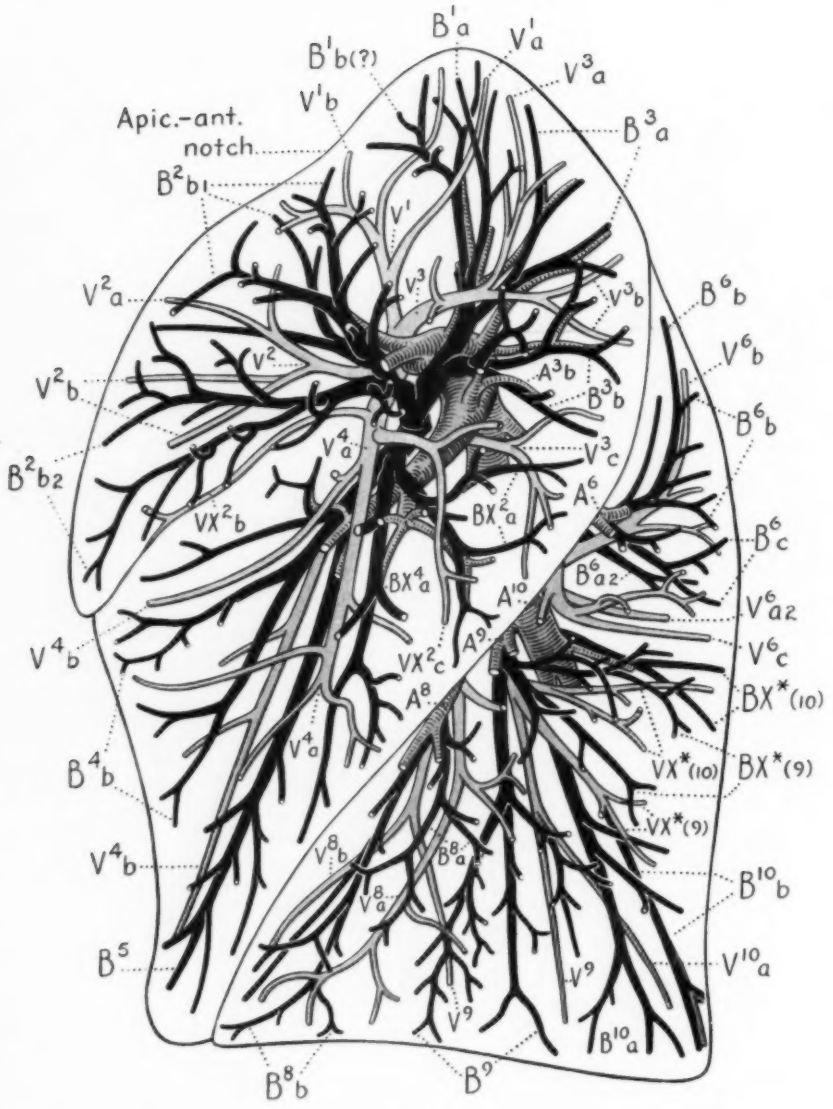
B¹a
V¹a
B¹b(?)
V³a
V¹b
Apic.-ant.
notch
B³a
B²b1
V¹
V³
V²a
V³b
B⁶b
V⁶b
V²
A³b
B³b
V²b
B⁶b
V⁴a
V³c
B²b2
A⁶
BX²a
VX²b
B⁶c
BX⁴a
B⁶a2
A¹⁰
V⁶a2
V⁴b
A⁹
VX²c
V⁶c
A⁸
BX*(10)
V⁴a
VX*(10)
BX*(9)
B⁴b
VX*(9)
V⁸b
B⁸a
V⁴b
B¹⁰b
V⁸a
B⁵
V¹⁰a
V⁹
V⁹
B¹⁰a
B⁸b
B⁹

PLATE II

Plate II: Lateral View of Left Lung

Left Upper Lobe: In this specimen the left upper lobe bronchus divides into the usual superior and lingular divisions, but beyond this point the bifurcations give rise to four atypical segments. The apical-posterior bronchus of the upper division bifurcates into a ramus which supplies the oblique surface of the lobe, B^3b, and a shrub-like ramus, $B^{1+3}a$. There is no distinct B^1b which heads for the apical-anterior notch; apparently it is represented both by the branch designated $B^1b(?)$ and the upper branch of B^2b1. The anterior bronchus (B^3) divides into anterior branches only (B^3b1 and B^3b2). Its clinically important posterior subsegmental bronchus (B^2a) is missing as such—a variation found in 35 per cent of 100 specimens (3). The lingular division divides into medial and lateral instead of into superior and inferior segmental bronchi, an arrangement found in 27 per cent of 100 specimens (3). In this lobe, the lateral bronchus gives rise to two displaced rami, BX^2a and BX^4a. The medial bronchus is the parent stem for B^4b and B^5.

The upper lobe arteries are five in number: A^3b, $A^{1+3}a$, $A^3a + b$, A^3b, and the lingular artery. Thus there is an overlapping of arteries to bronchial districts. However, the number of arteries is not unusual, the average being 5.4 per left upper lobe (4). The veins of the lobe are also atypical, for V^3c empties directly into the superior pulmonary vein instead of into V^3 (see Plate IIIB) and V^4a develops into a large vein that separa tes medial from lateral lingular segments.

Left Lower Lobe: The bronchi follow the usual pattern. Lateral branches of the anterior basal and lateral basal bronchi, B^8a and $BX^*(9)$, are co nspicuous in the lateral view. (Since the lateral branch of B^9 supplies the subsuperior zone, it is designated $BX^*(9)$. The other subsuperior bronchus, $BX^*(10)$, may be seen behind A^{10}. Both veins and arteries of the lower lobe are normal. Pa rticularly well developed are the veins that separate the superior and basal segments (V^6a2 and V^6c).

Plate III: Oblique Mediastinal Views

Left Oblique View (A): The right superior pulmonary vein (Sup.) is formed by the confluence of upper and middle lobe veins. The former receives apical, anterior, and posterior veins (V^1, V^2, V^3). The anterior vein is atypical in several respects: it receives an accessory vein from the upper surface of the middle lobe (VX^4a2; See also Plate I), and a displaced branch of V^3 (VX^3d); also its V^2a branch passes deep to B^2 (See also Plate I). The middle lobe vein receives a displaced vein from the inferior lobe (VX^6b). This runs in an anomalous fissure between the medial basal and anterior basal segments (See Plate IV). The inferior pulmonary vein (Inf.) is normal, being formed by the union of the vein from the superior segment (V^6) and the common basal vein. The latter is formed by the confluence of superior basal and inferior basal trunks (S and I, Plate IV). The veins from the medial basal segment are smaller tributaries. The one indicated by a double dagger (‡) underlies the pulmonary ligament.

The right pulmonary artery gives off a large truncus anterior, then continues into the interlobar fissure (as pars interlobaris) to supply the middle and lower lobes. Of special interest is the atypical arrangement of the medial basal artery which, with its associated bronchus, surrounds the inferior pulmonary vein. This is the Type III of Ferry and Boyden, which was found in 24 per cent of 50 specimens (7).

Right Oblique View (B): The left upper lobe is drained by the left superior pulmonary vein. Prevailingly the pattern is a radiate one with numerous branches arranged in a fan-shaped manner (4). In this specimen, however, there are only two principal vessels—a superior and a lingular vein. The first drains the three upper segments, but one of its branches (V^3c) follows a bizarre course (Plate II) to reach an anomalous position on the main trunk of the superior pulmonary vein (Plate III). The lingular vein is also atypical, V^5 being absent and V^4a assuming the role of separating medial and lateral segments. The inferior pulmonary vein drains the lower lobe in the usual manner, being formed by confluence of the vein from the superior segment (V^6) and the common basal vein. Into the latter, drain superior basal and inferior basal veins (S and I). The smaller V^7, indicated by a double dagger (‡), underlies the pulmonary ligament.

The left pulmonary artery gives off a series of five upper lobe arteries, only three of which are visible in this view. The lower lobe artery, after giving off A^6, divides normally into $A^7 + A^8$ and $A^9 + A^{10}$ (*cf.* Plate II).

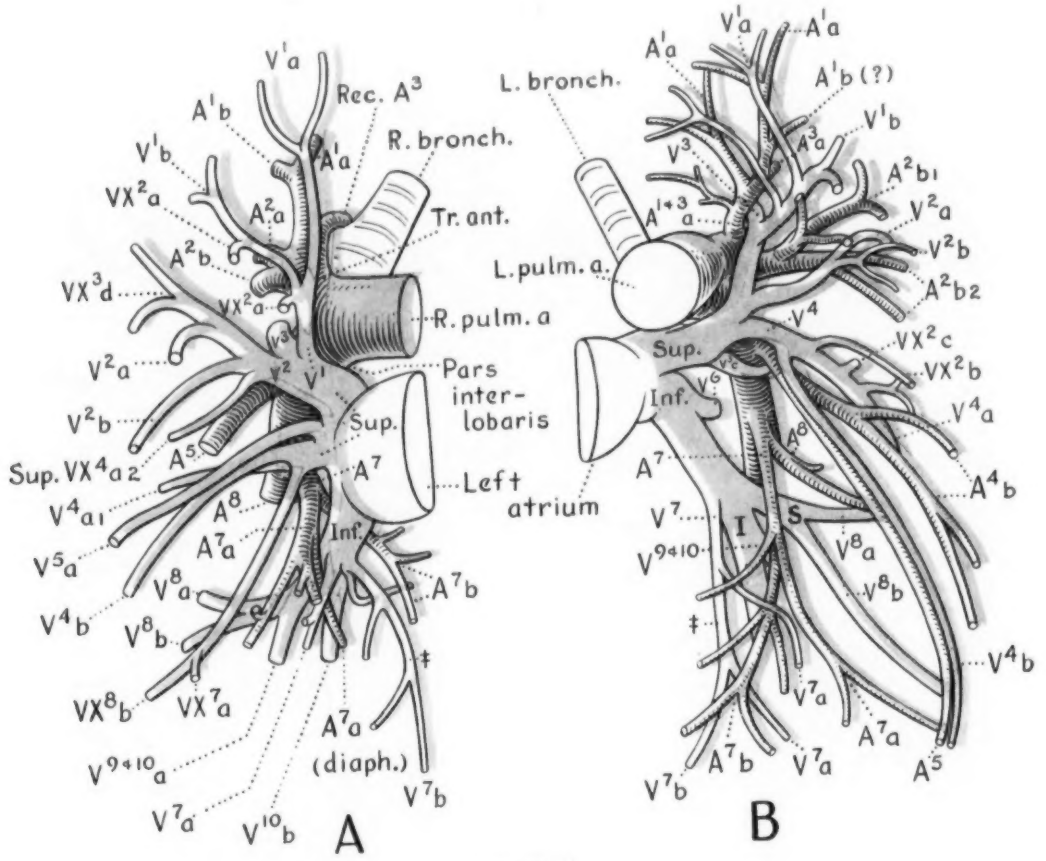
V¹a
Rec. A³
A¹b
R. bronch.
A¹a
V¹b
VX²a
A²a
Tr. ant.
A²b
VX³d
VX²a
R. pulm. a
V³
V²a
V²
V¹
Pars inter-lobaris
V²b
Sup.
A⁵
Sup. VX⁴a 2
A⁷
Left atrium
V⁴a 1
A⁸
Inf.
A⁷a
V⁵a
A⁷b
V⁸a
V⁴b
V⁸b
‡
VX⁸b
VX⁷a
A⁷a (diaph.)
V⁹+¹⁰a
V⁷b
V⁷a
V¹⁰b
A
L. bronch.
V¹a
A¹a
A¹a
A¹b (?)
V¹b
A³a
V³
A²b1
A¹+³a
V²a
L. pulm. a.
V²b
A²b2
V⁴
Sup.
VX²c
VX²b
V⁶
Inf.
V⁴a
A⁸
A⁷
A⁴b
V⁷
I
S
V⁸a
V⁹+¹⁰
V⁸b
‡
V⁴b
V⁷a
A⁷a
V⁷b
A⁷b
V⁷a
A⁵
B

PLATE III

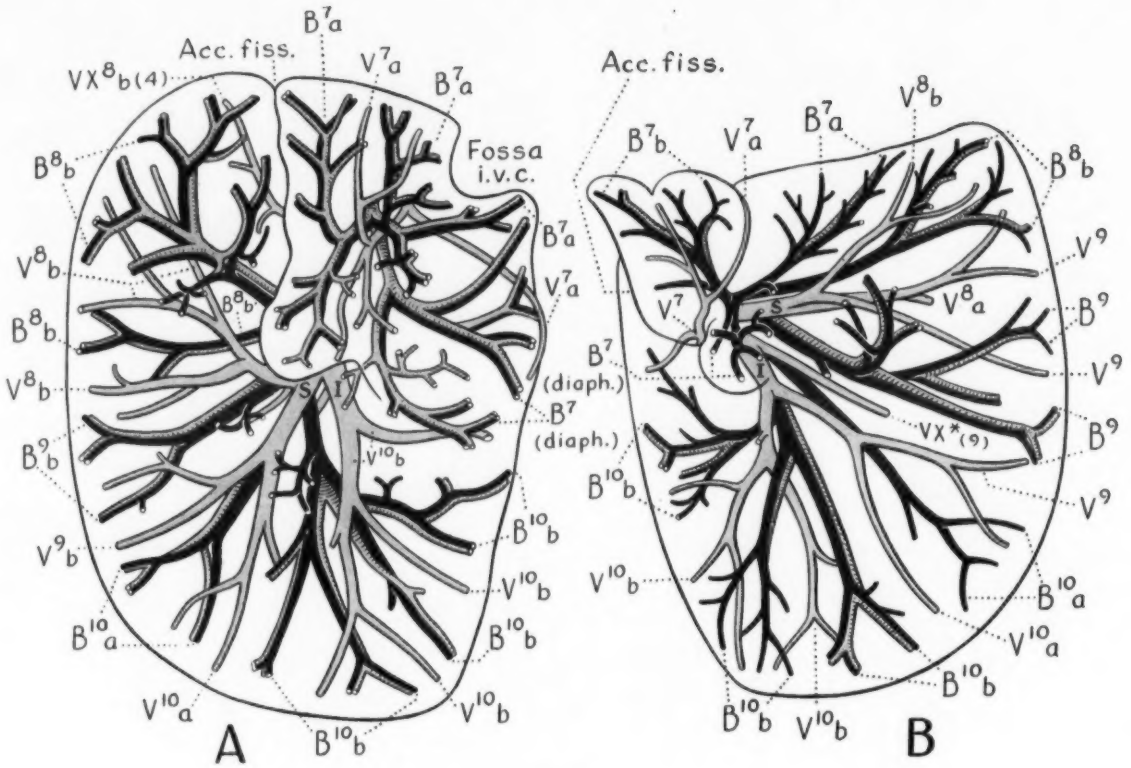
Acc. fiss.
B^7a
V^7a
B^7a
$VX^8b(4)$
Fossa i.v.c.
B^8b
B^7a
V^8b
V^7a
B^8b
B^8b
V^8b
S
I
B^7 (diaph.)
B^9b
$V^{10}b$
V^9b
$B^{10}b$
$V^{10}b$
$B^{10}a$
$B^{10}b$
$V^{10}a$
$V^{10}b$
$B^{10}b$
A
Acc. fiss.
B^7b
V^7a
B^7a
V^8b
B^8b
V^9
V^7
S
V^8a
B^9
B^7 (diaph.)
I
V^9
$VX^*(9)$
B^9
$B^{10}b$
V^9
$V^{10}b$
$B^{10}a$
$V^{10}a$
$B^{10}b$
$B^{10}b$
$V^{10}b$
B

PLATE IV

Plate IV: Diaphragmatic Views

Right Lung (A): This view reveals the presence of a "cardiac lobe" containing the medial basal segment. In the limiting fissure runs the atypical vein described in Plate I—VX^8b, a tributary of V^4. The distribution of bronchi to the medial basal segment is atypical. First, there is a diaphragmatic branch which virtually constitutes a third subsegmental bronchus. However, since it is a branch of B^7a, it has been labeled B^7 (diaph.). Secondly, B^7b fails to reach the diaphragmatic surface. Its higher paravertebral position is indicated by the corresponding artery (A^7b) in Plate IIIA; also its atypical position behind the inferior pulmonary vein. The basal structures follow the usual pattern except that the superior basal vein (S) drains a substantial portion of the posterior basal segment (B^{10}). More commonly it is formed by the union of V^8 and V^9.

Left Lung (B): This view also reveals the presence of an accessory fissure on the left lung, which separates the medial basal segment (B^7) from adjoining territories. The segment is deficient in that it does not reach the angle between anterior and costal surfaces, the former being occupied by B^8b. Also, like the corresponding bronchus on the right side, it has a prominent diaphragmatic branch. The basal bronchi and veins are fairly typical.

an expert. When received, the cast appeared to consist of a mass of minute terminal branches. It took weeks of patient removal of peripheral parts to expose the larger branches. Then the latter were drawn by the writer with as great fidelity as possible, and rendered for publication by the artist, Lawrence B. Benson.

Each view of the lungs is briefly analyzed in the legends of the plates, but to facilitate the use of the terminology a drawing of the bronchial tree from the writer's 1949 article in *Diseases of the Chest* (2) is reproduced as Figure 1. Here the bronchi (named in accordance with the Jackson-Huber terminology) have been numbered B^1 to B^{10}. Bronchus 1, for instance, divides into two branches, here designated B^1a and B^1b. (Either of these may be further subdivided, as B^1b into B^1b1 and B^1b2.) Corresponding arteries (not seen in the figure) receive the designation A^1a and A^1b. Veins lying on the counter-clockwise side (right lung) or clockwise side (left lung) of a given bronchus as seen in an *anterior* view (such as Fig. 1) receive the number of the bronchus (V^1a, V^1b, etc.).[3] Except in the middle lobe (a five-sided polyhedron), the order is reversed in lateral views, namely, clockwise for the right lung, counter-clockwise for the left lung.

Anticipating conclusions, one may state that in each of these lungs there are three major bronchial variations. Vascular anomalies are still more numerous.

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[3] Branches of V^2 and V^3, draining several segments, are lettered in the order in which the branches come off (*e.g.*, V^2a, V^2b, V^2c, V^2d).

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SUMARIO

Vistas Laterales de los Segmentos Bronquiales y de los Vasos Pulmonares Asociados en una Preparación Inyectada de los Pulmones

Aunque, en su mayor parte, se conocen bastante bien los bronquios segmentarios, hasta fecha reciente se ha prestado poca atención a la identificación de las ramas subsegmentales, aun siendo las unidades que cambian más frecuentemente de posicion en el árbol bronquial. Tan común es ese cambio de ciertas partes que virtualmente todo par de pulmones se caracteriza por numerosas desviaciones de la supuesta normalidad. Aun menos conocida es la posición que ocupan los principales vasos pulmonares en las proyecciones laterales de los pulmones.

Para ilustrar algunos de esos puntos, el A. presenta vistas laterales de un par de pulmones perfectamente inyectados (y por lo tanto absolutamente inflados), ejemplares esos que se parecen muy de cerca a los órganos vivos. Esas imágenes laterales van complementadas con reproducciones de las caras mediastínicas y diafragmáticas, de modo que en una forma u otra quedan comprendidas todas las partes de cada ejemplar. En las ilustraciones, los bronquios aparecen teñidos de negro, las arterias de rojo y las venas de azul.

En cada uno de los pulmones reproducidos obsérvanse tres grandes variaciones bronquiales. Las anomalías vasculares son todavía más numerosas.

Hysterosalpingography[1]

LAMAN A. GRAY, M.D.

THE INTRODUCTION of radiopaque solution into the uterus, fallopian tubes, and peritoneal cavity is performed with respect and some reserve by the gynecologist. The reasons are obvious and well documented. The careful exclusion of contraindications, to be elaborated upon in some detail, the disadvantages of certain radiopaque materials, and the various complications, sometimes fatal, are given due consideration. The ascertainment of anatomical features and technic of introduction are complementary to the observation and interpretation of the radiologist at the fluoroscopic table. The value of the procedure, especially in the treatment of sterility, is reiterated in this paper.

The rather extensive literature on the subject shows a majority of authors most enthusiastic. The history of the procedure, the methods, and introduction of different media are worthy of some review. Cary (1), in 1914, reported the use of Collargol, described later in the same year in the German literature by Rubin. Because of irritating reactions, it was discontinued. The next report was in 1923 by Kennedy (2), who used 20 per cent sodium bromide. While this author was enthusiastic, others found rather marked reactions (3). In 1922, Lipiodol was used in the spine and joints with favorable results (4). Heuser (5), in 1925, described its use in South America, advising hysterograms in the diagnosis of pregnancy. In 1926 Béclère (6) and others published accounts of the use of Lipiodol for hysterosalpingograms, and since that time many reports have appeared in the French literature. In fact, this substance has extraordinary popularity in France. In 1927 and later, Jarcho (7, 8) in America wrote favorably of hysterosalpingography in various uterine, tubal, and ovarian diseases. Many other papers have subsequently appeared. Iodochlorol was described as another popular oily medium (9). In 1938, Titus, Tafel, McClellan, and Messer (10) tried Skiodan with acacia, with good results, rapid absorption, and less reaction. This was to meet the growing anxiety over reactions to the oily media. In 1941, Rubin (11) introduced Viscorayopaque, a complex iodine compound in polyvinyl alcohol. This rapidly absorbed, water-soluble material has been a great improvement. Palmer (12) recommended Lipiodol-F, a less viscid oil solution, as having produced no serious reactions in his experience of 196 cases.

A consideration of these various media, on the one hand oily and on the other water-soluble, is of great importance in view of reactions that may be produced. The oily materials, such as Lipiodol, are very slowly absorbed, sometimes over weeks, months, or even years. The very viscid oil is readily trapped in occluded or sacculated tubes and commonly produces a foreign-body reaction with partial absorption of oil into phagocytes. The microscopic picture of this type of inflammation is very characteristic. Foreign-body granulomas have been described in the pelvic peritoneal cavity from retained oil (13). At times, the subsequent salpingitis is most severe, producing permanent sterility, requiring major destructive operations, and even causing death (14, 15). The accidental introduction of the oil into veins may be followed by syncope, shock, oil pneumonia with recovery, or oil embolism with sudden death (16, 17, 18). While relatively few fatalities have been reported, it is likely that a number have occurred. A death from oil embolism occurred in Louisville in

[1] From the Department of Obstetrics and Gynecology, University of Louisville, School of Medicine, Louisville, Ky. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

1939 following the introduction of Lipiodol into uterine sinuses in a patient with an unrecognized pregnancy complicated by myomas of the uterus.

Skiodan with acacia, recommended in 1938, was welcome, and no deaths from its use have been reported, so far as we are aware. Its rapid absorption and water solubility tend to produce less reaction. Jennings (13), however, has reported 13 per cent allergic reactions, none serious. Others have noted increased pain (19).

Rayopaque has been popular, with no serious reported reactions. In our own series of 103 hysterosalpingograms with Rayopaque, there was 1 instance of transient urticaria, and 2 patients had slight lower abdominal pain and slight fever for several days. Other newer water-soluble media are under investigation in various centers.

Reactions, mild or serious, are lessened if the contraindications to hysterosalpingography are observed. Vaginitis and cervicitis should be largely eradicated in order that bacteria may not be introduced into the upper genital tract. A severe cervicitis should certainly be treated by cauterization and healing should occur before hysterosalpingography is instituted. While Heuser used Lipiodol for the diagnosis of uterine pregnancy, this latter condition is a strong contraindication for hysterosalpingography because of the possibility of producing abortion or infection, and of introducing the radiopaque medium into the veins beneath the embryo. The procedure is also contraindicated by uterine bleeding, because of possible open veins. X-ray diagnosis in suspected cancer of the uterus, while advised by some, is generally undesirable because of the possible introduction of malignant cells and bacteria into the tubes and peritoneal cavity. Any degree of active inflammation in the fallopian tubes contraindicates hysterosalpingography, particularly with the very viscous oil preparations. An evaluation of pelvic pain, tenderness, induration, adherent ovaries, and pelvic adhesions is a most important prerequisite to the procedure.

X-ray diagnosis has been accomplished by two methods, the first by the introduction continuously of rather large amounts of the medium, 8, 10, or 12 c.c., and more recently by the fractional method (20), using 1.5 or 2 c.c. at intervals, up to a total of 6 or 10 c.c., the films being made at each interval. Finally a twenty-four-hour film is usually considered advisable to prove patency of the tubes. Various manometers have been recommended to prevent overdistention, above 200 mm. of mercury. Most procedures have utilized films, without fluoroscopic observation.

The use of small amounts of Lipiodol (5 or 6 c.c.) was considered important because of the very slow absorption of this substance and local inflammatory reactions (21). The fractional method seems especially important for the study of lesions of the endometrial cavity, such as polyps, submucous myomas, septal defects, or cancer.

In our opinion, the most important use for hysterosalpingography is in sterility, in which patency of the fallopian tubes is of paramount importance. We prefer the introduction of a relatively large amount of the medium, not only for the diagnosis of tubal obstruction, but for the purpose of thoroughly opening the tubes. Fortunately the water-soluble media cause little local reaction and are rapidly absorbed. The introduction of 8, 10, or 12 c.c. produces most satisfactory demonstrations, with characteristic semilunar shadows about the ovaries and between loops of bowel. Twenty-four hour films are unnecessary.

Patients complaining of sterility have the usual studies, including history, physical examination, semen analyses, basal metabolism, and ovulation studies. If gynecologic examination shows no infection, no bleeding and no pregnancy, transuterine tubal insufflation is performed three to five days following menstruation, to be repeated on two or three occasions at intervals of one, two, or four months. This test, with carbon dioxide, is performed first because of its harmlessness if done with

care. If the tubes are normally open to the repeated test, and pregnancy has not occurred, hysterosalpingography is performed.

On this occasion the pelvic organs are reexamined three to five days following a menstrual period. At the roentgenologist's fluoroscopic table the speculum is inserted, the cervix is grasped with a tenaculum and cleansed with an aqueous antiseptic, and the cannula is inserted. A 10-c.c. syringe containing 12 c.c. of an aqueous medium (in our preference, Rayopaque) is attached. The cannula is not locked to the tenaculum, but simple manual pressure is preferable, for rapid release. In the darkened room, the radiologist observes the slow introduction under manual pressure. The patient is not anesthetized, nor is sedation used. Pain reaction is considered most important. The radiologist observes the gradual filling of the uterus, the tubes, and finally the escape of the contrast material from the fimbriated extremities. Two or three films are made during filling, the apparatus is then removed and the expulsion of material from the uterus is observed fluoroscopically. Finally, after momentary ambulation, one concluding horizontal film is secured.

The whole procedure requires only a very few minutes. The generous amount of material injected leaves no doubt as to findings. Pain is minimal during the procedure, and has usually been nil thereafter. Should the radiologist see the contrast material entering the pelvic veins, the injection is immediately terminated.

The tubal factor in sterility is probably the most important single one involving the female. Closed tubes have been found in 13 per cent and 15 per cent by McLane (22) and Krebs (23), respectively, while partial occlusion occurred in 54 per cent of Winson's (24) sterile patients. Transuterine tubal insufflation has long been recognized as of great value in increasing fertility. A number of reports indicate that hysterosalpingography may give a higher percentage of fertility than insufflation, 28 per cent as compared with 10 per cent according to White (25) and three or four times better according to Green-Armytage (26). It seems that viscous solutions are more effective than gas in straightening kinks or stretching adhesions. Rutherford (15) has reported that in 417 patients with tubes closed to the Rubin test, opening was effected in 71 per cent with repeated hysterosalpingography. The procedure has been considered far superior to surgical salpingostomy, the latter being successful in 10 to 30 per cent of cases. The non-operative pressure treatment was used by Grant and Mackey (27) with pressures up to 250 or 300 millimeters of mercury. In 53 of 124 patients with blocked tubes, satisfactory tubal patency was achieved, and 23 became pregnant.

Our series comprised 285 cases of sterility: 26.5 per cent of 49 patients who had treatments other than insufflation or hysterosalpingography became pregnant; 23.5 per cent of 140 who in addition had Rubin tests, and finally 30.3 per cent of 89 who in addition had hysterosalpingography, usually preceded by insufflations, conceived. In 51 of this group of 89 both tubes were open, in 18 one tube was open, and both tubes remained closed in 12 cases.

Thirty-seven patients had partial obstruction to carbon dioxide gas. Twenty-seven of these had normal hysterosalpingograms and 10 had one tube open. Of 14 patients with completely negative Rubin tests at 200 millimeters of mercury, 3 had both tubes opened, 2 had one tube opened, and in 9 neither tube could be opened.

There were no serious reactions in these patients, with the use of Rayopaque. In 1 patient urticaria developed temporarily. Two had slight low abdominal pain and low-grade fever for a few days. There was no known intravasation. The occurrence of pregnancy shortly after hysterosalpingography in certain patients, long treated by other means, was impressive.

This paper does not include the numerous other factors in the field of sterility to be investigated in clinical treatment. It does draw attention again to the important value of hysterosalpingography in the in-

vestigation and treatment of sterility, but indicates that there are contraindications to be observed. Water-soluble media in generous amounts prove beyond question that the tubes are open, apparently without the occasional but serious risk attending the introduction of oily media. Cooperation between the gynecologist and radiologist, the latter having fluoroscopic control, seems to offer the best result.

SUMMARY

1. Hysterosalpingography is again shown to be of value in the diagonosis and treatment of sterility. This procedure was performed in 89 patients, of whom 30.3 per cent became pregnant. Tubal insufflation alone was performed in 140 patients, and 23.5 per cent conceived.

2. Aqueous media are necessary in our opinion. Many references to complications from oil attest to its occasional but serious danger.

3. The best results are obtained through the combined efforts of the gynecologist, who must exclude complications and use careful technic, and the radiologist, who contributes fluoroscopic control and radiographic interpretation.

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SUMARIO

Histerosalpingografía

Demuéstrase de nuevo que la histerosalpingografía es de valor en el diagnóstico y el tratamiento de la esterilidad. El procedimiento fué ejecutado en 89 enfermas, 30.3 por ciento de las cuales quedaron después embarazadas. La insuflación tubaria sola fué llevada a cabo en 140 pacientes, 23.5 por ciento de las cuales concibieron.

Opina el A. que se necesitan medios acuosos. Muchas referencias a complicaciones observadas al utilizar medios oleosos comprueban el riesgo ocasional, pero grave, que encierran.

DISCUSSION

Fred Coe, M.D. (Washington, D. C.): Our first salpingograms were made shortly after Béclère made his first announcement in 1926. We used Lipiodol then, and I have used it ever since, without a single serious reaction. Follow-up studies and laparotomies after periods from one to five years have shown no macroscopic pathological changes associated with retained Lipiodol in the peritoneal cavity or tubes. Nor did the patient have symptoms that could be attributed to retained Lipiodol. Foreign-body reactions have been reported in the literature, and Dr. Paul Titus is outspoken in his condemnation of this medium in tubal insufflation. Dr. Claude Béclère, however, with a long experience in thousands of cases, stated that there are few complications attending its use. Although the staff at Georgetown University Hospital, including myself, investigated Viscorayopaque, and I wrote a report on its use in cystourethrography, it was never used in hysterosalpingography, because of its unstable nature.

An opaque medium which is quickly absorbed is not satisfactory, as the twenty-four-hour and seventy-two-hour follow-up films are very important. Many times these reveal patency in tubes which would have been reported as occluded at the fluoroscopic examination or immediately after injection.

Fluoroscopic observation during injection is time-consuming, is not accurate without films, and subjects the radiologist to exposure to radiation of which he already has too much. There is also a hazard in subjecting the ovaries of the expectant mother to excessive radiation.

Skiodan with acacia is a fair medium, but the possibility of foreign-body reaction due to nonabsorbability of the acacia must be considered. The essayist has enumerated most of the contraindications to salpingography. I would add that in no case should such an examination be made for at least two months following dilatation and curettage.

In 2 cases of early pregnancy injections were made with no interruption of the pregnancy, and satisfactory delivery ensued. Both of these patients had irregular menstrual histories, but it is likely that an A-Z examination would have obviated our studies.

Our injections are made without fluoroscopy. Experience in injection will tell the amount of pressure required to fill the uterus and tubes. One can easily feel the resistance when the uterus is filled. Passage of the medium through the tube is indicated by the pressure; if there is a definite block, it is obvious. I strongly condemn the use of mechanical devices such as compressed air or other means of making the injection.

My survey of our first group of cases early in 1930 indicated a higher percentage of consequent pregnancies than the essayist reports. We are now making a survey on all cases from 1946 to 1952. One gynecologist has referred 4 patients in whom we have found greatly dilated sacs at the fimbriated ends of the tubes, with complete occlusion. After surgical repair, we have shown patency in all 4 cases, and in 3 pregnancy with delivery has resulted.

My experience in hundreds of cases would indicate that complications of Lipiodol injection are of little consequence. Adequate pelvic survey by a qualified gynecologist, observation of the stated contraindications, and experience in performing the injections make hysterosalpingography a valuable procedure in sterility cases.

Dr. Gray (*closing*): Dr. Coe has had so much more experience than I have had that it is of great interest to me to listen to him. While Green-Armytage of London, for example, says he has done some 400 or more hysterosalpingograms with Lipiodol, sometimes with intravasation and shock, but all with recovery, a number of fatalities have been recorded.

It is of interest that Rayopaque is no longer on the market, because of difficulties in obtaining pure polyvinyl alcohol. There are other products at present under investigation, such as Medopaque by Bell-Craig. So far we have seen no reaction with the latter. We understand it is quite water-soluble and should give no oil embolism.

Medullary Fixation of the Femur[1]

HUGH SMITH, M.D.

Memphis, Tenn.

THE SCOPE OF medullary fixation of the femur is now well defined. Under ideal circumstances, this method can now be accepted as sound therapy, offering many advantages over older and more orthodox forms of treatment. The nail provides internal fixation sufficiently strong and rigid to eliminate the need for casts, splints, or braces. Nursing care is simplified. Early ambulation and weight bearing and mobilization of joints minimize the period of hospitalization and convalescence and decrease the final degree of disability to a minimum. Impaction or coaptation of the fracture surfaces is recognized as a desirable physiological stimulus to union. The medullary nail is a near-perfect mechanical appliance to take advantage of this favorable factor.

Over-zealous attempts, however, to capitalize on early mobilization and restoration of function in improperly selected cases can lead only to trouble. Surgeons with the most experience recognize the limitations of medullary nailing, and supplement the nail during part or all of the healing period with external support if the fracture is not rigidly fixed. Thus, the optimum advantages of the medullary nail do not accrue in all femoral shaft fractures nor in other long bones.

Before selecting this technic as the procedure of choice, a surgeon should realize that medullary fixation, more than any other, offers a great array of complications. Optimum results can be achieved only by the strictest adherence to the following requisites:

1. This technic is applicable only to a specific group of fractures.
2. The patient should be able to withstand a major surgical procedure.
3. Preoperative planning must be thorough, particularly the calculation of the length and diameter of the nail.
4. This is not a technic to approach casually; proper instruments, adequate assistants, and optimum hospital conditions are necessary for skillful insertion of the nail.
5. The limitations of metallic fixation apply to medullary nails; namely, the appliance will inevitably bend or break if subjected to undue strain during convalescence; a metal rod is not a substitute for union.

INDICATIONS

Medullary fixation is much too radical for fractures of children or adolescents. They get along quite well with simpler methods. Other than this, age is not a factor. Because of the anatomy of the canal, however, and the osteoporosis of the bone, the results of medullary fixation in elderly patients are likely to be less dependable and stable than in younger individuals.

Earlier experience should be limited to transverse or short oblique fractures in the middle two quarters of the shaft, *viz.*, 2 inches below the lesser trochanter and at least 7 inches above the adductor tubercle. As one gains in experience, the indication can be expanded to embrace comminuted or even segmented fractures, provided the degree of comminution does not preclude adequate supplemental fixation. The medullary nail will not prevent an accordion-like collapse of multiple small comminuted fragments over an area of several inches.

Beside its use in fresh fractures, nailing is a very satisfactory technic for delayed

[1] From the Campbell Foundation, Memphis, Tenn. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

union, malunion, non-union and for a variety of pathologic fractures.

The hazards of open reduction, antibiotics notwithstanding, are not to be weighed lightly. Infections will occur under the best of conditions. The presence of a compound wound, even though minor in extent, increases this possibility tremendously. As a primary procedure, use of the nail is definitely contraindicated; rather, suture the wound, apply skeletal traction, and nail the femur as a secondary stage after primary healing of the soft tissues is complete.

Multiple fractures or other coexisting injuries, such as burns or associated intrathoracic or intra-abdominal wounds, do not necessarily contraindicate medullary fixation. In many instances, the problem of multiple dressings or surgical procedures may be immeasurably simplified if cumbersome apparatus can be obviated by stable internal fixation. Consequently, medullary fixation may well play an important role in war or disaster surgery.

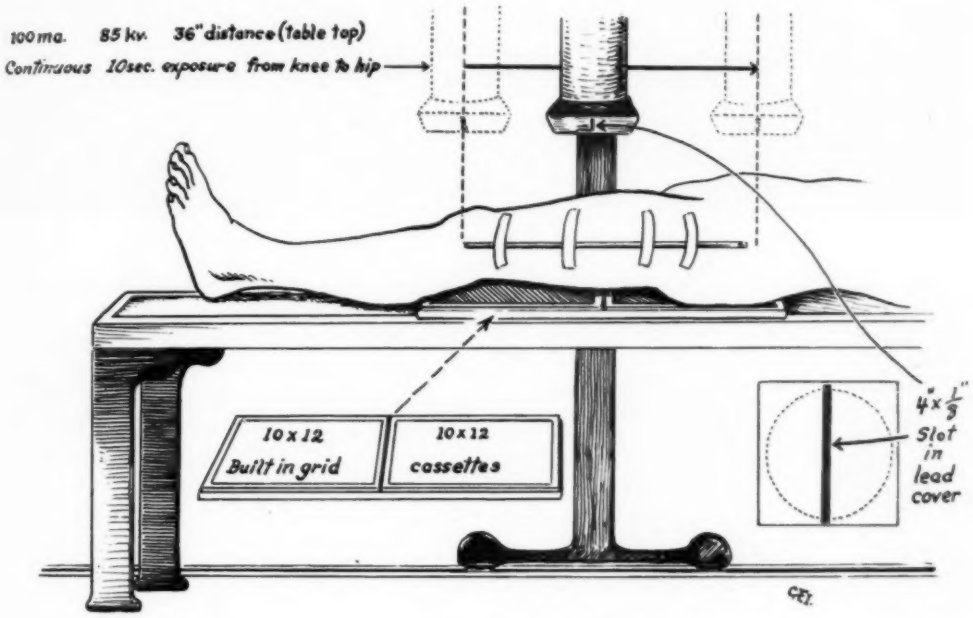

Fig. 1. Technic for a scanogram.

MEASUREMENT FOR NAIL

By careful execution of this phase of the preoperative planning many unnecessary complications will be obviated. A pin of known length and diameter is strapped to the lateral side of the normal thigh, parallel to the shaft. The distal end of the pin is level with the upper edge of the patella. Ideally, the pin should extend from just above the trochanter to the adductor tubercle and fit snugly in the canal. Roentgenograms of each end of the femur, or preferably a full-length scanogram, provide accurate data for simple calculations as to length. The diameter of the pin is estimated with a caliper by comparing measurements of the shadow of the measuring rod and the narrowest portion of the canal in the upper third of the bone.

SURGICAL TECHNIC

The patient is firmly strapped to the table on his side, the affected leg being draped into the sterile field for freedom of maneuvers. A lateral approach follows

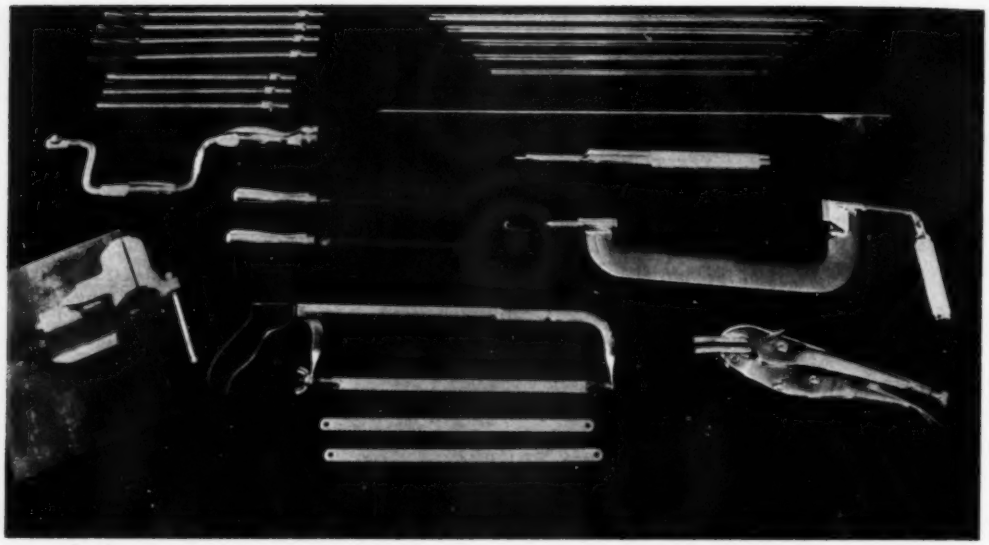

Fig. 2. Instruments for insertion and extraction of Kuntscher nails.

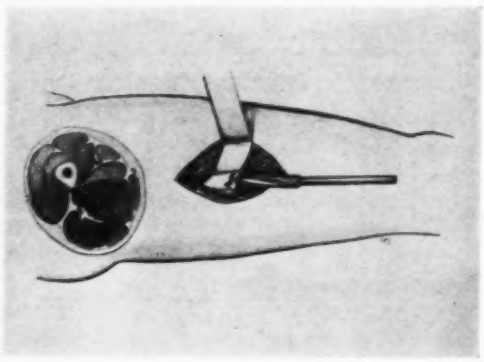

Fig. 3. Insert shows anatomic approach to shaft of femur. Reamer assures a canal of known diameter.

the inner surface of the fascia lata to the shaft; the fracture is reduced, proper alignment and rotary relations being ascertained. The distal fragment is delivered from the wound and the size of the canal is checked with a medullary reamer. The latter should be of the same diameter as the nail. This procedure is repeated on the proximal fragment. The reamer establishes a canal of proper size throughout the bone, thereby avoiding incarceration of the nail in the bone. The guide pin is inserted into the canal of the proximal fragment and drilled through the bone just medial to the greater trochanter, emerging through a small incision in the gluteal region. A cannulated intertrochanteric reamer introduced over the guide pin drills a hole through the trochanteric region in proper alignment with the canal. The nail is then fitted over the guide pin and driven down the shaft of the proximal fragment to the fracture site. The guide pin is removed and the fracture is reduced, with care that fragments are perfectly aligned. Finally, the nail is driven with the pin set into the distal fragment. Before closure, the following points should be checked: (*a*) stability of internal fixation; (*b*) the length of pin that protrudes above the trochanter; (*c*) the proper location of the nail, as determined by roentgen examination of the distal end of the femur.

POSTOPERATIVE CARE

Support, not immobilization, is provided for a week or ten days by a suspended and balanced Thomas splint with Pearson attachment. (If the fracture is unstable, apply a single spica cast.) Quadriceps set-up exercises are begun as soon as the postoperative reaction subsides. This is soon followed by straight leg raising and knee exercises. Until adequate callus forms,

the patient should splint the leg rigidly with the thigh muscles when moving around in bed. Usually half weight bearing with crutches, with a goose-step gait on the affected side, is permissible as early as the fourteenth day. The appearance of bridging callus at four to eight weeks permits a more normal gait. Crutches are discarded at twelve to sixteen weeks provided union is well established. The nails are removed ten to fourteen months after the fracture, assuming that bridging bone is strong and the fracture practically obliterated.

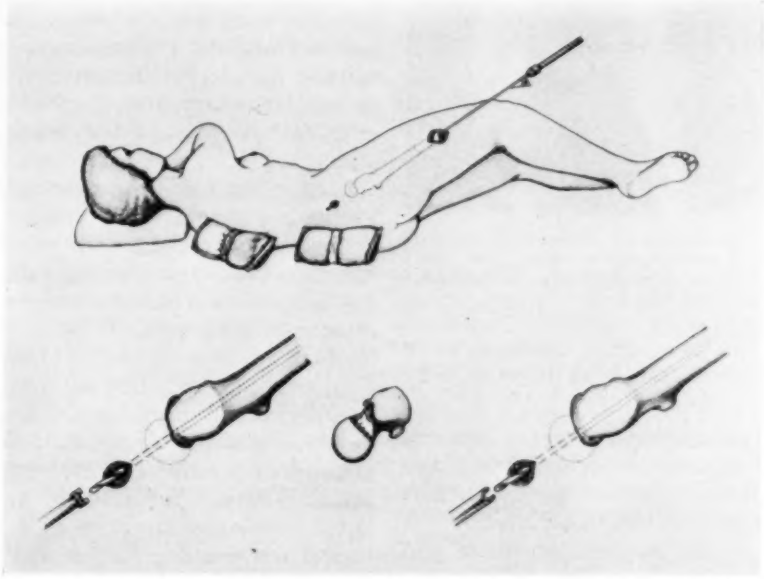

Fig. 4. Guide pin emerges through a small incision above the trochanter. Trochanteric reamer over guide pin drills hole in proper alignment with canal. Kuntscher nail, directed over guide pin, is driven down proximal fragment to fracture site, and guide pin is removed. With fracture reduced and aligned, nail is driven to proper level in distal fragment.

COMPLICATIONS—ERRORS IN TECHNIC

An unduly prolonged or traumatic procedure can produce an alarming state of shock, even death. Prophylaxis in the form of the proper equipment and personnel, skillful surgery, and a generous quantity of blood, before and during the operation, is mandatory.

Fat embolism and thrombophlebitis or thrombophlebosis are not uncommon after femoral shaft fractures. Their occurrence is certainly no more frequent with this technic than with any other. In a reported series of 700 femoral nailings, fat embolism did not occur in a single instance.

Infection is an undesirable complication that may occur after any open procedure on bones. Routinely, antibiotics should be administered preoperatively, assuring an adequate coverage in blood clots or other static areas. The occurrence of an infection, even an osteomyelitis, does not necessarily mean a disastrous result. The infection usually remains localized to the fracture site, and union occurs uneventfully. Drainage, however, may continue until a sequestrectomy is performed and the nail extracted.

The most common errors of technic are based upon "guesstimating" the length and diameter of the nail. A long nail protrudes above the trochanter into the gluteal muscles. A bursa or ossified cap forms over its end, but the patient complains of pain and limps until the nail is removed.

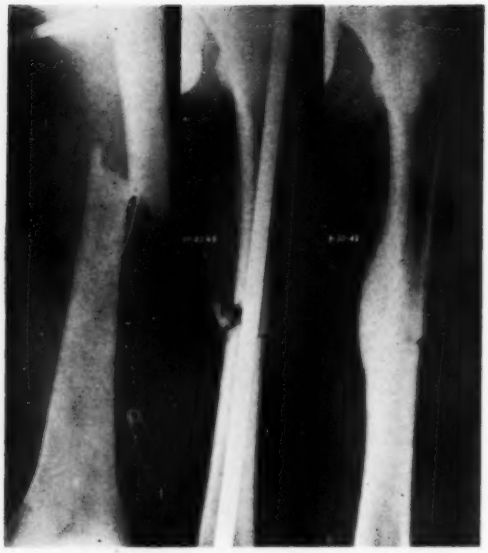

Fig. 5. Early experiences with medullary nails should be limited to this type of fracture, *viz.*, short oblique or transverse. Do not remove nail until fracture is thoroughly healed.

Obviously this is a more desirable error than a long nail in the other direction, *viz.*, driven into the knee joint.

A short nail affords inadequate fixation and may be responsible for splitting of the shaft and loss of position as the patient begins exercises and weight bearing. Or, a short nail, as the cortices lose their grip upon it, may drop to a lower level in the canal, and its recovery and extraction become a very difficult task. A nail that fits loosely in the canal is an indication for external supplementary support; otherwise, rotary deformities are likely. Further, the side-to-side play of the two fragments seems to interfere with both the quantity and quality of the callus. A large nail firmly imbedded in the medullary canal may resist efforts either to drive it farther or to extract it. An embarrassing experience of this type produces a healthy respect for the difficulties of medullary fixation.

Errors in inserting the pin contribute their share to the long list of complications. If the shaft of the bone is unduly bowed in an anterolateral direction, or if the canal is very large, the nail may be directed at an angle, such that the end emerges in the anteromedial segment of the suprapatellar pouch of the knee; or it may engage the cortex of the distal fragment and distract the fracture site. Dense or sclerotic bone may split if the nail is too large or is directed into an improperly aligned distal fragment. So-called transverse fractures are frequently accompanied by an incomplete butterfly fracture of the medial and posterior portion of the cortex. Only close scrutiny reveals its presence. The nail usually dislodges the butterfly fragment. A supplementary wire loop is indicated, even though fixation may appear to be stable.

During the convalescence period, roentgenograms should be obtained at regular intervals of four, eight, and twelve weeks to ascertain the development of callus. With minimal callus, a conservative course is indicated. Most patients with medullary fixation develop a sense of false security, even bravado, and may succeed, by some injudicious act, in bending or breaking the nail. A bent nail is not an indication for manipulation, which succeeds only in creating an S-shaped curve in the nail and an almost impossible situation as far as extraction is concerned. Rather, the bent nail should be extracted and a new one inserted, a generous quantity of iliac bone chips being sprinkled about the fracture to encourage early union. An unattended bent nail is usually the first stage of a broken nail, a far more complicated situation.

Medullary fixation is a sound method of treatment offering many advantages over more standard procedures. The consensus of experienced surgeons is favorable. These, more than any others, however, appreciate the many complications peculiar to this technic. An indifferent or nonchalant attitude toward its adverse potentialities is a prelude to a chastening experience.

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SUMARIO

La Fijación Medular del Fémur

En las fracturas de la diáfisis del fémur, la fijación medular posee numerosas ventajas sobre los procedimientos más aceptados. Sin embargo, está expuesta a complicaciones graves y exige sumo cuidado en su preparación y ejecución. Para obtener los mejores resultados, hay que observar las siguientes normas: cuidadosa selección de los casos; capacidad del enfermo para tolerar un procedimiento de cirugía mayor; meticulosa preparación preoperatoria, en particular con respecto al largo y al diámetro de la clavija; instrumental apropiado, asistencia adecuada y óptimas condiciones hospitalarias.

Las radiografías de ambos extremos del fémur, o aun mejor, una escrutografía de todo el largo, aportan datos exactos para calcular la longitud y el diámetro de la clavija. Al radiólogo también le corresponde determinar la localización apropiada de la misma, después de introducirla, y obtener radiografías durante la convalecencia para averiguar la formación de callo, de lo cual depende la futura evolución del caso.

Se ofrecen aquí la técnica del procedimiento, junto con los detalles de la asistencia postoperatoria. Las complicaciones que sobrevienen proceden de la infección, la longitud impropia de las clavijas, errores en la introducción y encorvamiento de las clavijas.

DISCUSSION

Donald S. Childs, M.D. (Syracuse, N. Y.): I do appreciate very much the care with which Dr. Smith selects his cases. The introduction of an intramedullary nail, as he said, should be used in the mid two-fourths of the bone. He is rather careful in his operative procedure, his postoperative care and dressings.

The radiologist has a part in this procedure. First, he should determine the site of the fracture and its type. The measurement of the sound leg, or the nail strapped to the side of the sound leg, must be very carefully done. We use the ordinary scanning methods (almost any one of them will work) or, as was mentioned, the method of marking the proximal and distal portion of the shaft with the ruler marked to give a definite measurement may be used.

I believe most surgeons like some guidance during the introduction of the nail to determine at the close of the operation whether the nail is in its proper place, whether the femur has been fragmented, whether the nail is in the shaft or outside, whether it projects too far distally or too far proximally. That is the radiologist's part of the problem.

The question after three, four, five, or six weeks is whether the localized osteoporosis at the site of fracture is due to the surgical interference, or possibly due to a localized infection. I believe that in that problem, also, the radiologist can assist the orthopod.

The amount of weight-bearing that the patient is going to use, or be allowed, has nothing to do with the amount of callus. I think you noticed on Dr. Smith's films that in the cases where there was a great amount of callus you could trace the line of fracture through the callus. The callus was almost the size of the bone, plus the bone itself, and still you could see the line of fracture going through that portion of the callus. Certainly at that time weight-bearing, unguided, may bring a rather serious complication. The serious complications Dr. Smith gave us are the bending or the breaking of the nails. These are not easy to handle. A broken nail, with displacement, is something that puts gray hair in the orthopods' heads.

In the surgical procedure the medullary cavity is reamed out, usually. A foreign body is put in this medullary cavity. The nutrient artery of the femur is sheared. I wonder if Dr. Smith would like to hazard a guess whether in five to six years we are going to see an aseptic or perhaps a septic necrosis at the fracture site.

Pneumoencephalographic Studies Following Complete Removal of Supratentorial Lesions[1]

AARON J. BELLER, M.D., AND ARMIN SCHWARTZ, M.D.

PNEUMOENCEPHALOGRAPHY, introduced by Dandy, is of paramount importance for the localization of intracerebral lesions. It also has its merits in the study of anatomical changes *in vivo*, as pointed out by Foerster. In the course of our work we have had the opportunity of studying the changes in the brain, particularly the ventricular system, occurring after the removal of well encapsulated supratentorial space-occupying lesions. In all the cases selected for this purpose the lesions were well delimited and were completely removed.

The 10 cases upon which this study is based comprised 5 abscesses, 3 meningiomas, 1 ecchinococcus cyst, and 1 encapsulated tumor which seemed to be a meningioma but proved on histopathologic examination to be an oligodendroglioma. The purpose of the study is to direct attention to the changes in the ventricular system caused by supratentorial space-occupying lesions, and their reversibility as shown by preoperative and postoperative air studies.

CASE I: S. K., a boy of six and a half years, was admitted on Aug. 16, 1948, because of convulsive seizures of jacksonian type of ten days duration. The boy was known to have congenital heart disease. On examination a right pyramidal and sensory syndrome was found. Pneumoencephalography on Aug. 18 localized the lesion in the left parietal region (Fig. 1A and B). At operation, Aug. 20, a large abscess was completely removed. Recovery ensued. Postoperative pneumoencephalograms, Nov. 12, 1948, are reproduced in Figure 1C and D.

CASE II: J. G., a 32-year-old woman, was admitted on July 11, 1949, with a history of headache of nine years duration, mental disturbances for the past four years, and complete blindness which had developed in the last few months. On examination, secondary optic atrophy was evident and there were pyramidal tract signs on the left. X-ray examination of the skull revealed complete destruction of the sella turcica. The preoperative ventriculogram (Fig. 2A), obtained on July 26, disclosed a right parieto-occipital space-occupying lesion. At operation on the same day a parasagittal parieto-occipital meningioma weighing 220 gm. was removed. Except for blindness, the patient recovered. A second pneumoencephalographic study was performed on Sept. 16 (Fig. 2B).

CASE III: S. U., a 36-year-old male, was admitted on March 29, 1950, with severe left frontal headache of ten days duration. Positive neurologic findings were: right central facial weakness and an extensor toe sign on the right. Pneumoencephalography on March 30 showed a left frontal lesion. There were slight distortion of the left frontal horn, some compression of the body of the left ventricle, and depression of the left temporal horn. Air was absent in sulci over the left hemisphere but present over the right.

The same day an abscess was evacuated through a left frontal burr hole. Penicillin was administered locally and systemically. On April 10 the capsule of the abscess was enucleated. Recovery was uneventful. Ninety-five days after operation, encephalograms showed cyst-like dilatation of the left anterior horn and slight dilatation of the right ventricle. No air was demonstrable in the sulci, but there was a small quantity in the basal cisterns.

CASE IV: C. A., a 48-year-old housewife, had suffered from left jacksonian seizures for the past five years. On admission, April 15, 1951, she was disoriented and exhibited a left central facial weakness and beginning bilateral papilledema. Pneumoencephalography, March 28, revealed a right temporal lesion. There was a moderate shift of the ventricular system to the left, with narrowing of the body of the left lateral ventricle; the temporal horn of the right lateral ventricle was cut off, and there was a small amount of air in the subarachnoid space.

At operation, April 16, a well encapsulated tumor was removed from the region of the right sylvian fissure. The neoplasm was at first thought to be a meningioma but proved on histologic examination to be an oligodendroglioma. Postoperative pneumoencephalography, June 7, showed the ventricular system in the mid-line position and some dilatation of the right lateral ventricle, mainly its anterior horn, and of the subarachnoid space.

CASE V: S. R., a 12-year-old boy, was brought into the emergency room of the hospital on June 1, 1951, in status epilepticus, with seizures of left

[1] From the Neurosurgical and X-Ray Departments of the Rothschild-Hadassah-University Hospital, Jerusalem, Israel. Accepted for publication in July 1952.

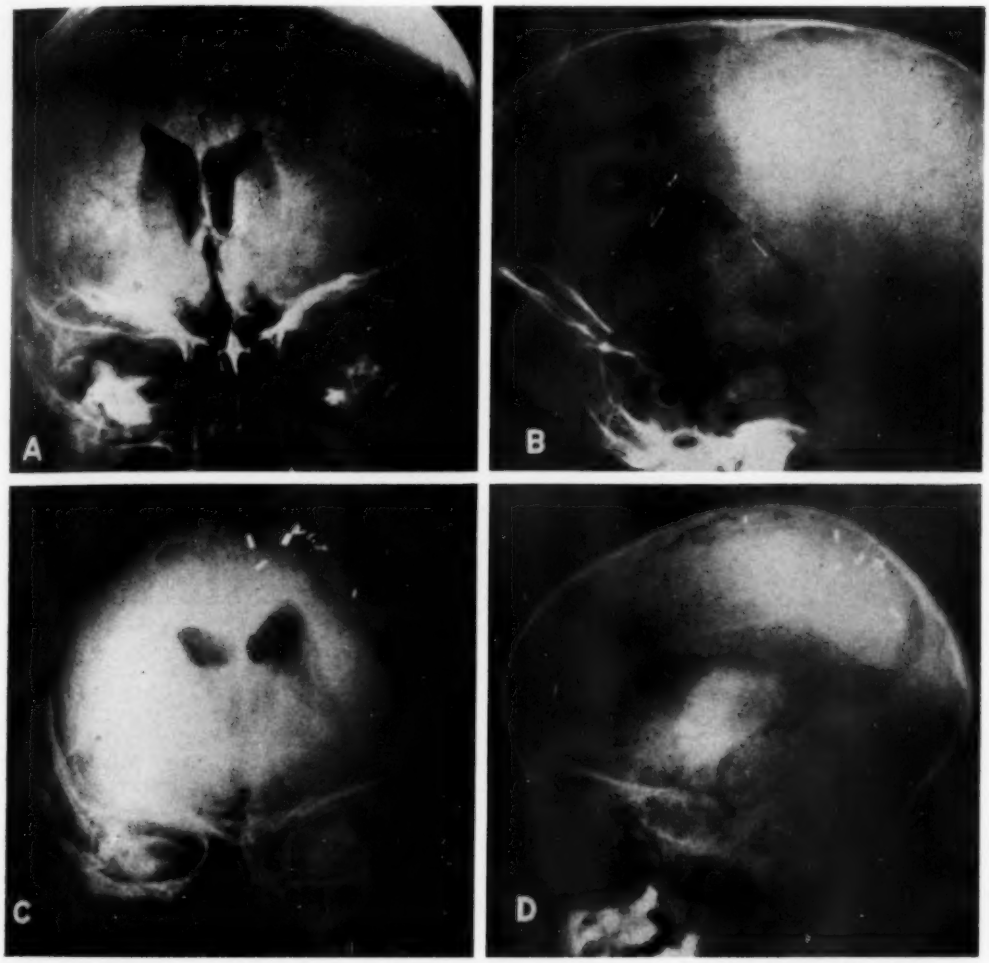

Fig. 1. Case I. A and B. Anteroposterior and right lateral pneumoencephalograms showing shift of ventricular system to the right with depression and compression of the body of the left ventricle; air absent over the hemispheres.

C and D. Anteroposterior and right lateral encephalograms eighty-four days after operation, showing the dilated ventricular system in mid-line position, with local dilatation of the posterior third of the left ventricle and air in normal quantity over the hemispheres.

jacksonian type. He was known to have a chronic discharge from the right ear. Pneumoencephalography on June 14 (Fig. 3A and B) localized the lesion in the right temporal lobe. On June 17 a well encapsulated abscess was removed. Pneumoencephalographic studies were repeated on June 30 (Fig. 3C and D).

CASE VI: S. A., an 18-month-old girl, was admitted to the Pediatric Department on July 1, 1951, with a clinical diagnosis of meningitis. While in the hospital, the child experienced right-sided seizures. Air studies on July 3 revealed a left temporal lobe lesion. There was a marked shift of the ventricular system to the right, the right temporal horn was elevated, and there was a small amount of air in the basal cistern, with absence of air over the left hemisphere. An abscess was aspirated and treated locally. On July 22, complete enucleation was performed. Recovery ensued. Postoperative pneumoencephalography was performed on Aug. 14, demonstrating a dilated ventricular system in normal position. There was an increase of air in subarachnoid space over the left hemisphere.

CASE VII: S. C., a 9-year-old boy, was first admitted on Sept. 4, 1951. He displayed a clinical picture consistent with a supratentorial space-occupying lesion, with secondary optic atrophy on the right and papilledema on the left. There were

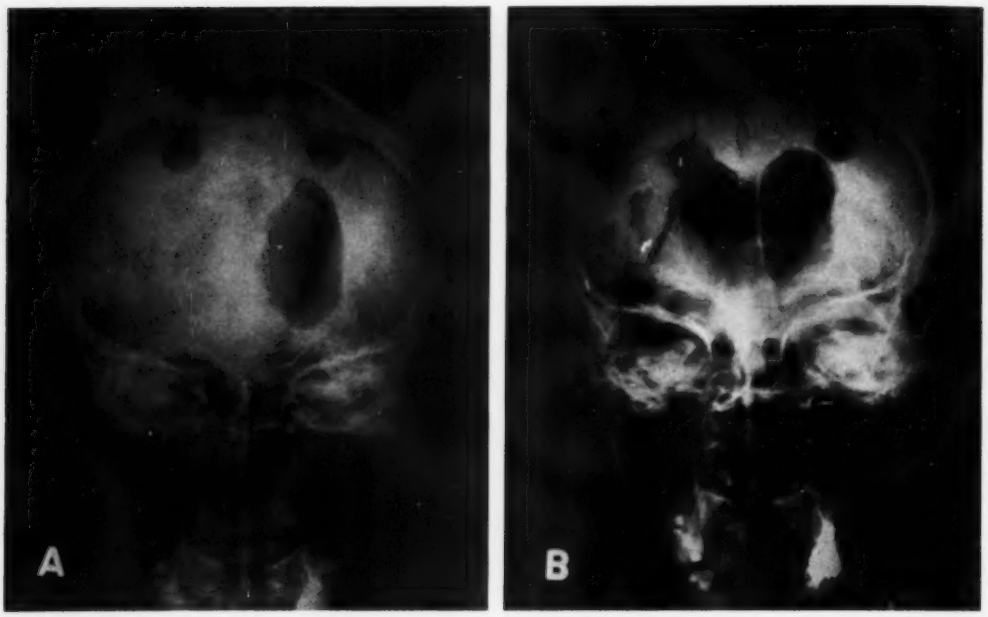

Fig. 2. Case II. A. Anteroposterior ventriculogram showing filling of the greatly dilated left lateral and third ventricles, with dislocation toward the left; air absent in subarachnoid spaces.
B. Anteroposterior encephalogram fifty days after operation, showing the markedly dilated symmetrical ventricular system in mid-line position; some air in subarachnoid spaces.

no other localizing signs. Electroencephalography indicated a focus in the left frontal region. Pneumoencephalography, performed on Sept. 13 (Fig. 4 A and B), confirmed the diagnosis. On exploration, Oct. 8, no extracerebral lesion was found. Decompression was performed, and deep x-ray treatment was given. The patient was readmitted on Dec. 30, and re-exploration, Jan. 14, 1952, disclosed a large echinococcus cyst, which was completely removed, with uneventful recovery. Pneumoencephalography was repeated on Feb. 14 (Fig. 4C and D).

CASE VIII: M. J., a 20-year-old male, was admitted on Oct. 30, 1951, with headache of seven months duration, and deafness, left hemiparesis, and blindness for the past six weeks. On examination, the following signs were found: bilateral secondary optic atrophy, left central facial weakness, bilateral nerve deafness, and left spastic hemiparesis. Ventriculograms (Fig. 5A and B) showed a right frontoparietal lesion. At operation on the same day a right frontoparietal parasagittal meningioma (210 gm.) was completely removed. Recovery ensued, with some improvement of hearing but continued blindness. A second pneumoencephalographic study was performed on Nov. 22 (Fig. 5C and D).

CASE IX: R. L., a 39-year-old male, was admitted to the Neurological Department on Oct. 30, 1951, complaining of progressive weakness of the right extremities, accompanied by pain and right jacksonian seizures. Examination revealed a right motor and sensory hemisyndrome. Pneumoencephalography, Nov. 15, confirmed the clinical, electroencephalographic, and arteriographic findings. The ventricular system was pushed over to the right; the posterior half of the left lateral ventricle was compressed and depressed, and very little air was seen over the right hemisphere. On Nov. 19, a left frontoparietal parasagittal meningioma was completely removed. Pneumoencephalographic studies repeated on Dec. 10 showed the ventricular system dilated, symmetrical, and in mid-line position. Air was present in normal quantity over the left hemisphere.

CASE X: N. D., a 2-year-old boy, was first admitted to the hospital on Nov. 11, 1951, three days after a head injury. The day prior to his admission seizures involving the left side of the face and the left arm developed. X-ray examination of the skull showed a depressed fracture in the right frontoparietal region. On Nov. 26, the infected depressed fragment was removed and an extradural abscess evacuated. Recovery followed and the patient was discharged on Dec. 4. He was readmitted on Dec. 9 with left hemiplegia. Pneumoencephalography on Dec. 11 (Fig. 6A and B) disclosed a right frontal lobe lesion. An abscess was first tapped and on Dec. 18 completely enucleated. Postoperative pneumoencephalograms (Fig. 6C and D) were obtained on Jan. 8, 1952. The child recovered.

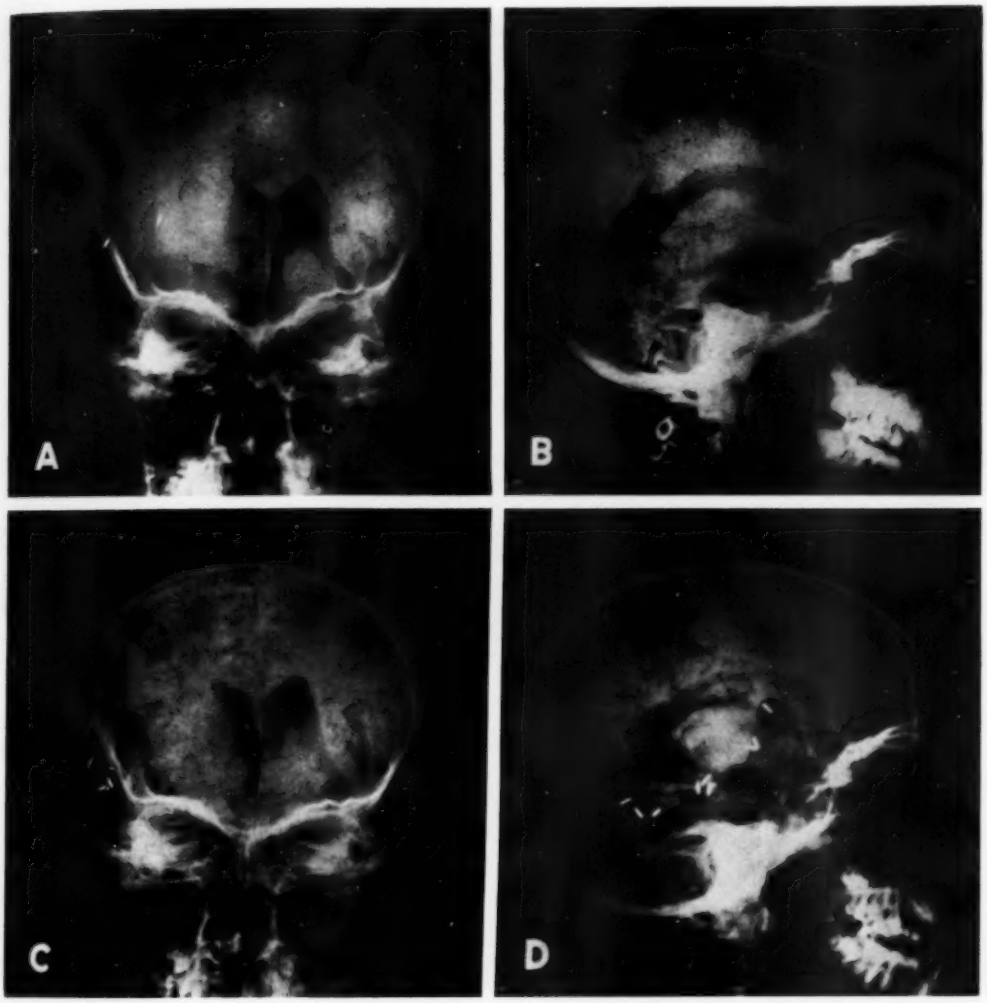

Fig. 3. Case V. A and B. Anteroposterior and left lateral encephalograms showing marked shift of the ventricular system to the left, absence of air in the temporal horn of the right lateral ventricle, subarachnoid spaces filled normally.

C and D. Encephalograms obtained nineteen days after operation, showing the somewhat dilated ventricular system in mid-line position, filling of the right temporal horn, and somewhat increased amount of air in subarachnoid spaces.

RESULTS

The most common feature of the postoperative pneumoencephalographic studies was the return of the displaced ventricular system to its normal mid-line position. This occurred irrespective of the lapse of time from the onset of the space-occupying lesion to the date of its removal. In Case II, for example, a right occipital meningioma was removed nine years after onset of symptoms. The shortest time interval in which return to a normal mid-line position was observed after removal of the lesion was fourteen days (Case V).

The other constant change after removal of the lesion was dilatation of the ventricular system, either symmetrical or asymmetrical. Symmetrical dilatation was observed in all 3 cases of meningioma, and in 2 cases of brain abscess. The other 3 cases of brain abscess showed a slight asymmetrical dilatation confined to one part of

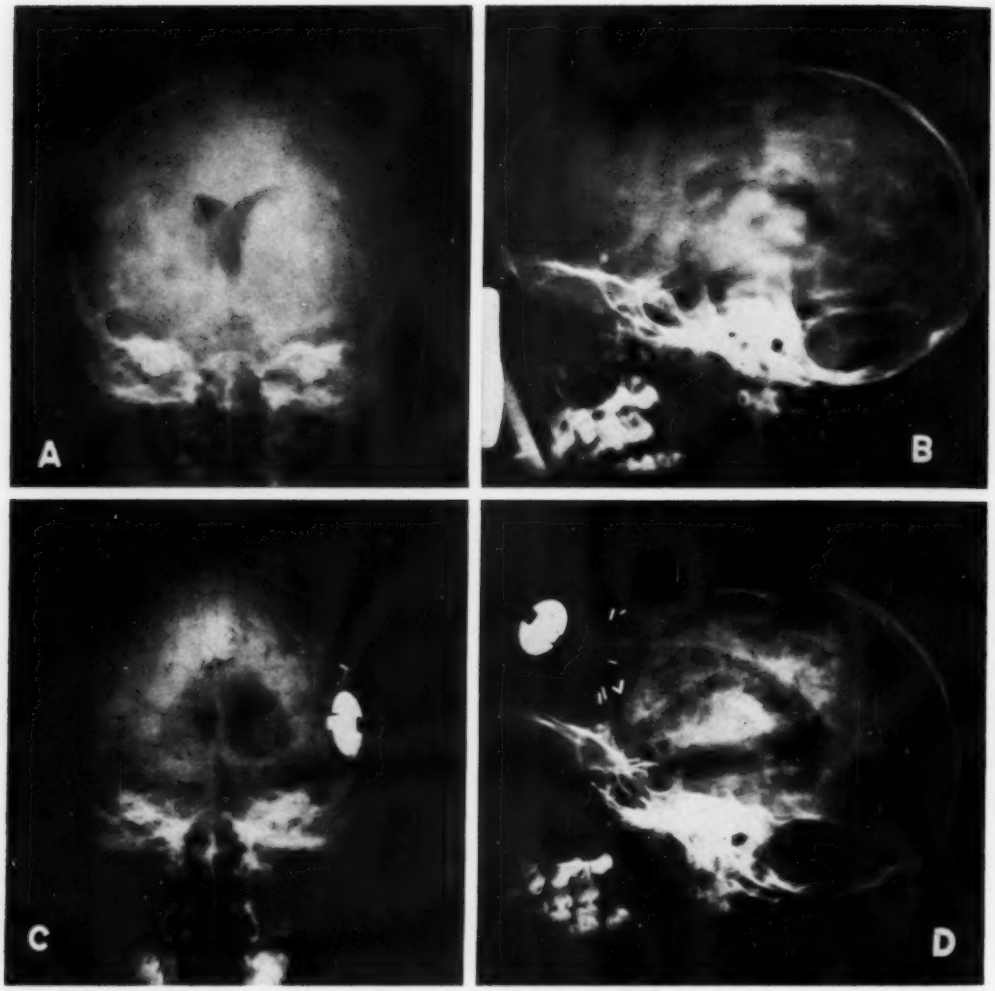

Fig. 4. Case VII. A and B. Anteroposterior and right lateral encephalograms showing marked shift of the ventricular system to the right, compression and narrowing of the anterior horn of the left lateral ventricle, and absence of air over the hemispheres.

C and D. Encephalograms made 140 days after operation, showing the dilated ventricular system in mid-line position, the anterior horn of the left lateral ventricle locally dilated, and air in normal quantity over the hemispheres.

the lateral ventricle. The remaining 2 cases showed asymmetrical dilatation postoperatively.

The subarachnoid spaces before operation showed no filling at all in 6 cases; in 3 cases there was slight filling on both sides and in 1 case there was filling on the side opposite to the lesion. After operation the subarachnoid spaces showed normal filling with some dilatation on the operated side in 9 instances. In 1 case only was there *no* filling of the subarachnoid spaces after operation, in spite of the preoperative presence of air.

DISCUSSION

The ventricular system returned to its normal mid-line position after the removal of the lesion causing its dislocation. This occurred in all 10 cases, irrespective of the site of the lesion (intracerebral or extracerebral), its type (neoplasm or abscess), or its

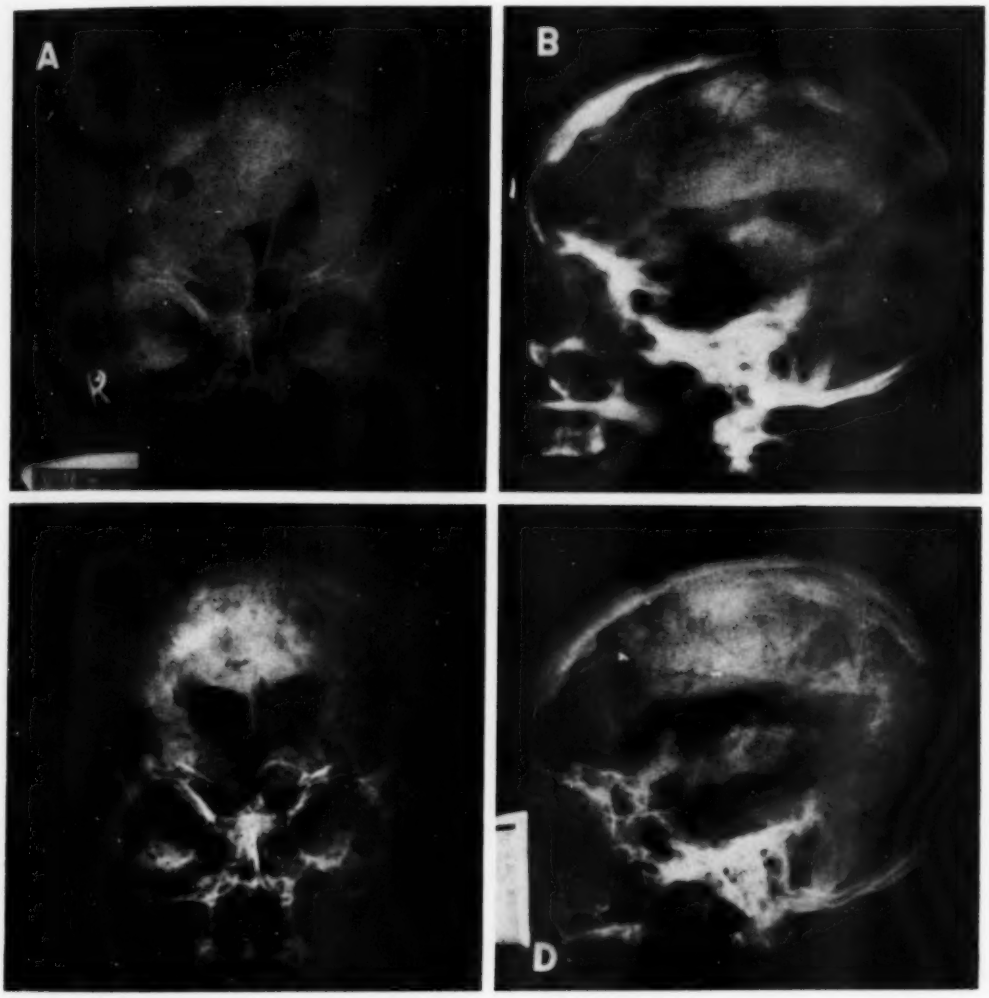

Fig. 5. Case VIII. A and B. Anteroposterior and left lateral ventriculograms, showing marked shift of the ventricular system to the left, depression of the anterior half of the right lateral ventricle, and absence of air in the sulci.

C and D. Anteroposterior and left lateral encephalograms seventeen days after operation, showing the symmetrically dilated lateral and third ventricles in mid-line position and air in sulci over both hemispheres (more over the left).

duration (fourteen days to nine years). The postoperative dilatation of the ventricular system is a compensation for loss of brain substance. This may be generalized, localized, or both. In all cases of meningioma—intracranial extracerebral lesions—the dilatation was symmetrical, irrespective of the time lapse between the removal of the lesion and the postoperative air studies. This indicates that the loss of brain substance due to meningioma is generalized and not local. In all intracerebral lesions ventricular dilatation was generalized as well as local, except in 2 cases of brain abscess where the air studies were performed two and three weeks after operation, respectively. This indicates that in intracerebral lesions the loss of brain substance is both general and local, the first as a result of general increased intracranial pres-

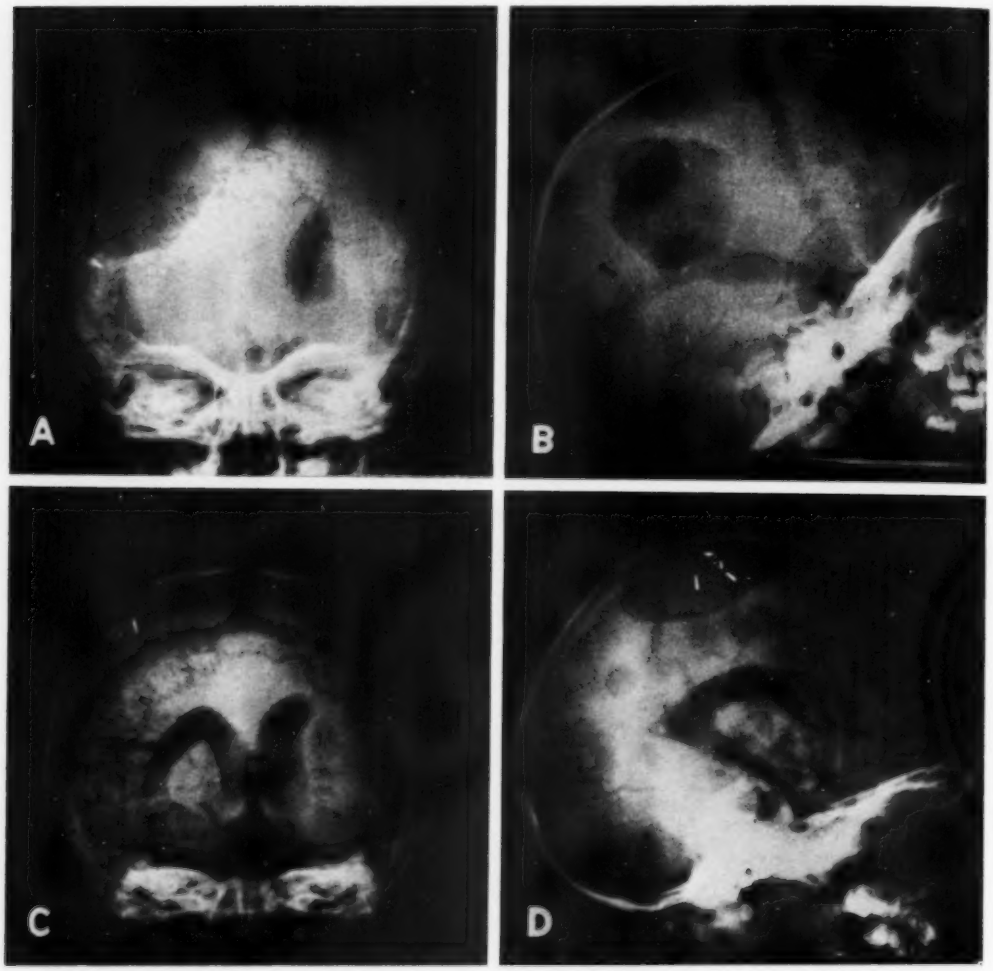

Fig. 6. Case X. A and B. Anteroposterior and right lateral encephalograms after removal of 90 c.c. of pus, and injection of 20 c.c. of air into the abscess cavity, showing the air-filled cavity the size of an apple in the right hemisphere, the somewhat dilated, depressed, and flattened left lateral ventricle displaced to the left, absence of air in the right lateral and third ventricles and over the hemispheres.

C and D. Anteroposterior and right lateral encephalograms twenty-seven days after operation, showing the symmetrically dilated lateral and third ventricles in mid-line position and air over both hemispheres (more over the right).

sure, the second due to local destruction of brain substance. The absence of local dilatation in the 2 cases of brain abscess is to be explained by the short interval between removal of the lesion and postoperative air studies.

This is supported by the observation made in the case of the most marked local dilatation, in which the postoperative studies were performed three months after the removal of the abscess. This late appearance of local dilatation of a part of the lateral ventricle after removal of an intracerebral lesion could be explained by two factors: first, the time necessary for glial scar formation and its retraction, which in turn would dilate the adjacent part of the ventricle by traction; second, the time necessary for the dilatation of the ventricle toward the cavity created by loss of brain substance. The loss of brain substance is compensated not only by dilatation of the

fluid chambers from within, but by refilling and dilatation of the subarachnoid spaces as well, including basal cisterns, this being observed in 9 out of 10 cases.

SUMMARY

1. Pneumoencephalograms were obtained after removal of encapsulated supratentorial lesion in 10 cases: 3 meningiomas, 5 brain abscesses, 1 echinococcus cyst, and 1 oligodendroglioma.

2. Postoperative return of the displaced ventricular system to its mid-line position was observed in all cases.

3. The ventricular system showed symmetrical dilatation in all cases of extracerebral lesions and in 2 of intracerebral lesions; in the other cases asymmetrical local dilatation was seen.

4. The subarachnoid spaces refilled and dilated after operation in 9 of the 10 cases.

ACKNOWLEDGMENT: We wish to thank Dr. A. Druckmann, head of the X-Ray Department, for his most helpful advice and co-operation.

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SUMARIO

Estudios Neumoencefalográficos Consecutivos a la Extirpación Total de Lesiones Supratentoriales

Estos estudios neumoencefalográficos fueron ejecutados antes y después de la extirpación de 10 lesiones supratentoriales encapsuladas (3 meningiomas, 5 abscesos cerebrales, 1 oligodendroglioma), con mira a llamar la atención sobre las alteraciones concomitantes en el aparato ventricular y la reversibilidad de las mismas.

En todos los casos, se observó retorno postoperatorio del aparato ventricular desplazado a su posición en la línea media.

Postoperatoriamente, la dilatación del aparato ventricular constituye una compensación de la pérdida de substancia cerebral. La dilatación fué simétrica en todos los casos de lesiones extracerebrales y en 2 de los de lesiones intracraneales. En los demás, resultó asimétrica.

En 9 de los 10 casos, volvieron a llenarse y a dilatarse los espacios subaracnoideos.

The Phlebographic Diagnosis and Treatment of the Post-Phlebitic Syndrome[1]

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THE USUAL CONCEPT of the post-phlebitic syndrome includes the early development of edema, induration, and pain on long standing, and such later changes as superficial varices, stasis cellulitis, atrophic skin with pigmentation, eczematoid changes, and eventually ulceration. By definition, there must of necessity have been a pre-existing thrombophlebitis or phlebothrombosis. However, the same clinical picture may result from other causes.

THROMBOPHLEBITIS OF THE DEEP VEINS

Thrombophlebitis of the deep veins, while usually occurring after surgery, trauma, or pregnancy, and in association with other conditions, may also develop idiopathically. It is, as a rule, amenable to a clinical diagnosis. However, there are situations in which this is not conclusive. While it is not usually of consequence to do so, it is possible to determine the diagnosis more certainly by the employment of phlebography.

Figure 1 is a fairly typical phlebographic picture of an acute postoperative venous thrombosis involving both the leg veins and the femoral vein in the thigh. The radiolucent areas with the medium passing about them in the deep veins of the leg represent thrombi. In most cases, at this stage there is not a complete obstruction. The medium, however, is partially forced into the superficial veins, which ordinarily are not shown by this method (1). In the thigh, the long saphenous is well made out along with the collaterals of the femoral vein. The femoral vein itself is probably totally occluded for its lower third, the medium again entering it in the middle third to visualize a distortion probably due to the presence of an intraluminal thrombus. As the process continues, more of the deep veins are involved and the superficial veins are forced to take over most of the venous return. There is a gradual readjustment, and months later the deep vessels canalize again but usually only after their valves have been damaged and with certain segments remaining totally occluded. Figure 2 is an example of this latter situation in a patient in whom pigmentation and eczematoid changes in the extremity have already developed. It is to be noted that by this time the superficial veins have failed to return to their normal state even through the deep veins are recanalized. In some individuals, the superficial veins are able to stand this extra load and return to their normal condition, remaining so throughout life.

VARICOSITY OF THE DEEP VEINS

It is reasonable to expect that the deep veins, as well as the superficial, might degenerate and become varicosed. As early as 1855 Verneuil, of Paris, described this condition and actually proved its existence by anatomical dissections (2). The clinical picture that he described is very similar to that which we know as the post-phlebitic syndrome. The popular neglect in making this etiologic diagnosis is probably due to the fact that the varices are often not obvious. However, in patients with this syndrome without other explanation, phlebography may again help to make the diagnosis. Figure 3 shows the phlebographic study on such a patient who has no past history of phlebitis or other deep vein obstructions. Here the tortuosity and even redundancy of the deep veins is clearly shown.

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[1] Presented at the Thirty-eighth Annual meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

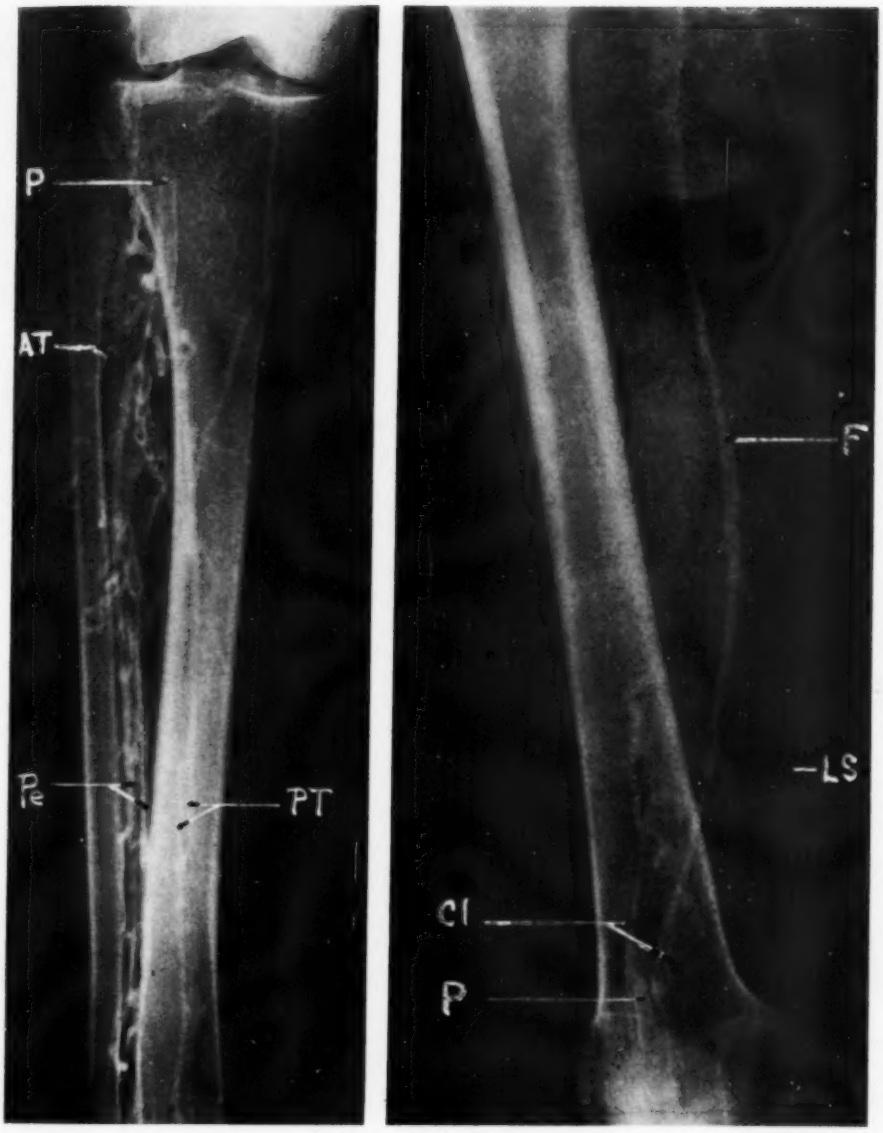

Fig. 1. Phlebogram of the right lower extremity of a 60-year-old white female with the clinical findings of an acute deep vein thrombosis.
P. Popliteal vein. PT. Posterior tibial veins. Pe. Peroneal veins. AT. Anterior tibial veins. Cl. Collateral veins. LS. Long saphenous vein. F. Femoral vein.

VALVULAR INCOMPETENCE SECONDARY TO MUSCULAR OR FASCIAL DEFECTS

To function properly, the valve leaflets in the veins must approximate each other for a distance. This requires that the diameter of the vein be within certain limits. If the vein wall is not properly supported, one can imagine that it may dilate to such an extent that the valves cannot function properly. It is also to be expected that the segment of vein below such a non-functioning valve will dilate as a result of the valvular incompetency. Assuming that the structures surrounding

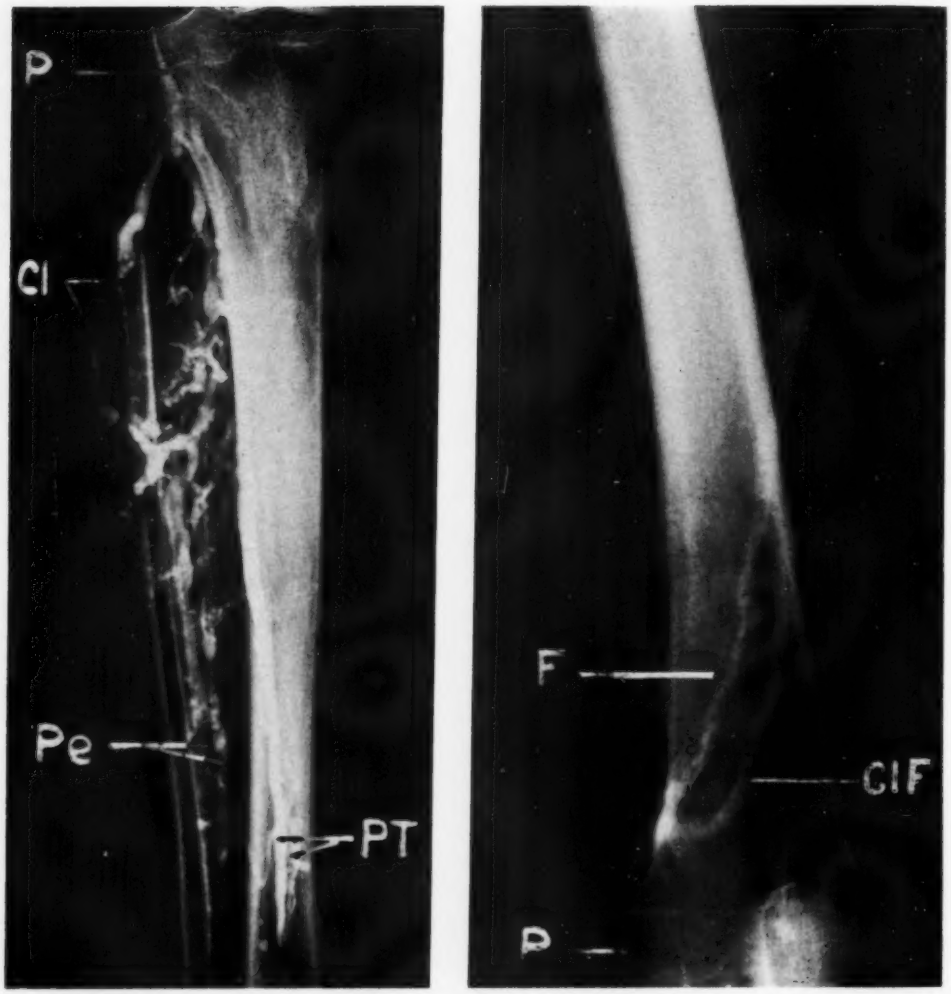

Fig. 2. Phlebogram of the right lower extremity in a 50-year-old white male several years after an acute deep-vein thrombosis secondary to an injury.
Pe. Peroneal veins. PT. Posterior tibial veins. Cl. Collateral veins about an old and persistent obstruction in the peroneal veins. P. Popliteal vein in spasm. F. Femoral vein with defects characteristic of canalization after thrombosis. ClF. Persistent collaterals about old obstruction in femoral vein.

the veins are of secondary importance, it is also possible that, should a valve degenerate, the dilatation of a vein below such a valve and the accompanying stasis might be secondary to the primary disease in the valve alone. It is very possible that either or both situations may obtain to produce a picture similar to that called the "post-phlebitic syndrome."

Figure 4 shows the phlebographic appearance of early segmental dilatation secondary to valvular incompetence. It should be noted here that the valve leaflets produce a horizontal defect in the contrast medium, which has been described as that of incompetent or at least partially incompetent valves (3). This phlebogram was made of the extremity of a young woman twenty-three years of age who had lateral swelling of the leg after long standing and early pigmentary changes. It is interesting that phlebo-

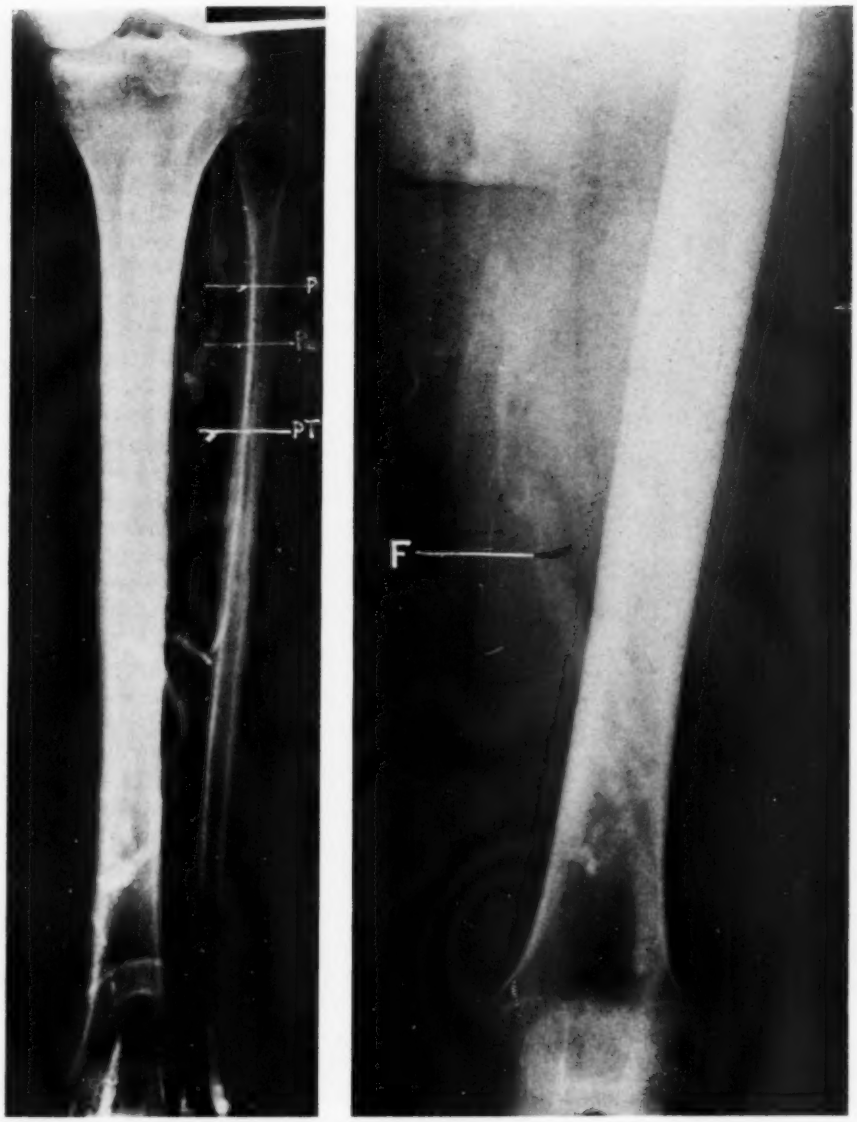

Fig. 3. Phlebogram of a 54-year-old white female presenting the clinical findings of the post-phlebitic syndrome but without a history of previous deep vein thrombosis. The dilatation and tortuosity of the deep veins is apparent.
PT. Posterior tibial veins. Pe. Peroneal veins. P. Popliteal vein. F. Femoral vein.

graphic study done in the morning did not show this swelling. It is also of interest that the patient's father had a similar condition and, further, that in two other instances where we have noted the condition, there was duplication of the venous tree as there is here. We believe that such duplication of the venous tree may be associated with early fascial or muscle defects which give rise to valvular incompetence.

VALUE OF PHLEBOGRAPHY IN DIAGNOSIS

In most instances acute venous thrombosis or thrombophlebitis can be diagnosed clinically and, even if there is some

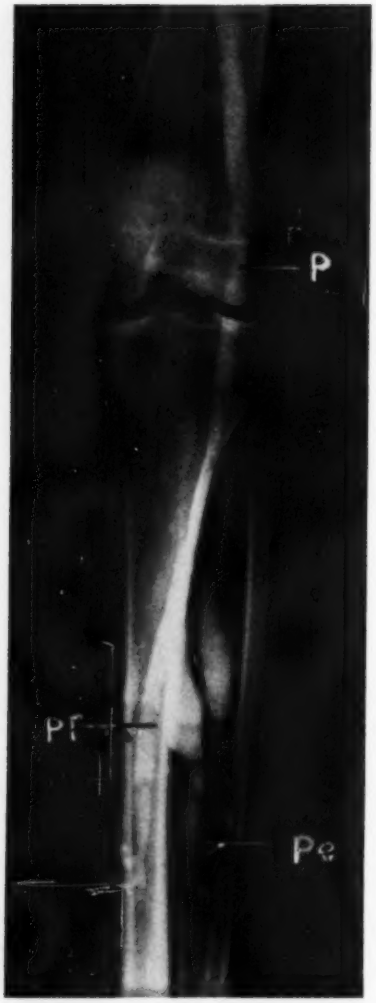

Fig. 4. Phlebogram of the left lower extremity of a 23-year-old white female presenting clinical findings of the post-phlebitic syndrome. Segmental dilatation (of the pantaloon type) with horizontal valve leaflet shadows in the peroneal veins. Bifid popliteal shadows are superimposed and so are not seen in this view.

Pe. Peroneal veins. PT. Posterior tibial veins. P. Popliteal vein.

question, treatment is such that it can be instituted without the necessity of a more accurate diagnosis. This is also true in the patient with the post-phlebitic syndrome who has a previous history of phlebitis or deep-vein thrombosis. As a consequence of this, and since phlebography may be hazardous in the acute thrombotic state, it probably has little to recommend it in these instances except for special study in teaching or research centers. It also should be mentioned that with the present-day methods of phlebography a certain number of cases could not be diagnosed due to the inadequacy of the technics.

TREATMENT

Conservative: Most instances of the post-phlebitic syndrome follow a deep-vein thrombosis, and usually thrombophlebitis, as shown by Zilliacus (4). The first line of treatment, therefore, should be to control deep-vein thrombosis early by the use of anticoagulants. We can thus minimize the sequelae, as emphasized so often by Ochsner and his colleagues (5).

In most cases it is possible to control the symptoms and to improve or minimize the signs associated with this condition by conservative treatment. This should include elevation of the foot of the bed at least 6 inches. This maneuver allows the patient to absorb the edema fluid accumulated during the day, including that edema, not always apparent to the eye, which is of great importance in the formation of the fibrosis characteristic of the chronically swollen extremity. During the day the edema is kept at a minimum by proper elastic support in the nature of wide, rubber-reinforced elastic bandages or elastic stockings. The former are to be preferred.

Since epidermophytotic infection may form a portal of entry through interdigital fissuring, involvement of the nail beds, and deep-seated bleb formation, these should be cleared up or avoided. To do this, good foot hygiene is essential. It is thought by some that such fungus infections are the basis for the recurrent attacks of cellulitis or even deep thrombophlebitis that these patients experience. The feet should be washed frequently; if an open lesion is present, they should be soaked for twenty minutes twice a day in any one of a number of simple fungistatic and bacteriostatic solutions such as soapy

water or mild Dakin's solution. Foot hygiene also includes daily changes of socks and the use of a foot powder, preferably one of the fatty acid esters. Whenever possible, the patient should alternate pairs of shoes every other day, so that the leather may thoroughly dry out in between times.

Patients suffering from the post-phlebitic syndrome should be urged either to walk about or to lie down for rest. Prolonged sitting or standing are conducive to venous stasis and to aggravation of the condition. It is interesting that in individuals who are persistently active, such as postmen and others who use their legs continuously and actively, the ultimate sequelae from the post-phlebitic state seldom develop. On the other hand, these advanced sequelae are very common among store clerks and people with similar occupations who, although on their feet all day, walk but a few steps at a time.

Once ulceration has occurred, it can be cleared up in most instances by the use of a modified Unna's paste boot with a reinforced elastic bandage or by the use of an elastoplast boot over gauze. It is seldom necessary to resort to complete bed rest to clear up such a condition. Once the patient with an ulcer learns a "new way of life," as described by Luke (6), including the factors mentioned above, he can easily control the condition without recurrence of the ulcer. Should such a patient be unable or unwilling to follow this routine, then surgery should be resorted to.

Surgical Therapy: Surgery consists first in ligation and stripping of the superficial veins and ligation of the perforating and communicating veins if these are incompetent. This usually requires some type of flap procedure similar to that proposed by Linton in 1938 (7). Ligation of the deep veins has been successful in sedentary individuals in reducing pain but is not a cure-all for this condition. It is contraindicated in patients who of necessity are very active on their feet.

For the occasional patient who has an intractable ulcer, excision of the entire ulcer and ulcer bed with skin grafting has proved successful. Some ulcers are so sensitive as to preclude any type of treatment locally. In these cases saphenous neurectomy of Atlas (8) has been of help.

When the element of vasospasm is great, repeated lumbar sympathetic blocks have proved of value. Sympathectomy is probably contraindicated, however, because of the possibility of development of a bizarre neuralgia plus an increase in the swelling of the extremity seen in some individuals.

For the intelligent patient who is willing to obey certain simple rules, the outlook is very hopeful.

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(*Para el sumario en español, véase la página siguiente.*)

SUMARIO

El Diagnóstico Flebográfico y Tratamiento del Síndrome Postflebítico

Por definición, el síndrome postflebítico va precedido de una tromboflebitis o flebotrombosis.

La tromboflebitis de las venas profundas puede, por lo general, diagnosticarse clínicamente, pero puede también usarse la flebografía para establecer con mayor seguridad el diagnóstico. La flebografía puede además ayudar en el diagnóstico de las varicosidades de las venas profundas y de la dilatación segmentaria secundaria a insuficiencia valvular.

En la práctica, como el procedimiento puede resultar peligroso en el estado trombótico agudo, el empleo del mismo está limitado en gran parte al estudio de casos especiales en centros de enseñanza y de investigación.

El tratamiento del síndrome postflebítico puede ser conservador o quirúrgico.

DISCUSSION

Louis G. Herrmann, M.D. (Cincinnati, Ohio): Dr. Felder has covered his subject very well and has left relatively little for me to discuss. He has demonstrated how varices within the substance of an extremity, either with or without incompetent valves of the perforating or superficial veins of that extremity, are commonly associated with swelling, induration, and ulceration. I believe it is a misnomer to refer to this syndrome as "post-phlebitic," and here in Cincinnati we like to call it the stasis syndrome.

This syndrome is responsible for a great deal of disability, particularly among those people past middle life. Dr. Felder has emphasized that secondary thrombosis within the incompetent deep veins is the late phase of the stasis syndrome which precipitates the ulceration of the skin of that extremity. Until we know more about the factors which precipitate intravascular clotting of blood, our treatment will have to be more or less empiric.

We agree wholeheartedly with Dr. Felder about the course of the stasis syndrome when it is allowed to progress without adequate treatment. The conservative measures of treatment, which may be very effective in the early stages, must be carried out over a long period of time. Every effort to overcome fungus infection between the toes must be applied rigidly if ulcerative lesions of the extremity are to be healed permanently. In the advanced stages of the stasis syndrome, it becomes imperative to eradicate all the incompetent perforating veins, as well as the incompetent superficial veins. The radical removal of these veins seems to be the only logical means of overcoming the condition.

The Care of the Incurable Cancer Patient

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THIS PRESENTATION has to do with the care of the incurable cancer patient. But it is not a subject of limited scope because it is confined to the problems of a hopeless disease. Cancer is preponderantly incurable, and the magnitude of the situation is almost incomprehensible. A frank discussion on management and treatment is particularly appropriate, therefore, at a meeting such as this, inasmuch as these are essentially a radiological problem.

The term "incurable" implies a malady from which recovery is beyond reasonable expectation. The term might properly be applied to an individual who is apparently beyond all human help because of a deeply rooted psychological disturbance or to the cardiac "cripple." These are circumstances, in no way immediately threatening life but nevertheless are hopeless conditions for cure, for which, however, very definite benefit can be achieved by carefully planned medical and nursing care.

The mass of afflictions in our general hospitals throughout the land are incurable. It is distressing to observe the futility of any kind of treatment for many of the advanced cardiorenal, arthritic, metabolic, tuberculous, and neuropsychiatric conditions, as well as a host of other pathologic entities.

Incurable cancer patients can be rightly divided into three groups. The first comprises those individuals who are able to be up and about. Many of them are able to continue with their routine duties at home or at work, and their earning capacity may be preserved for indefinite periods by palliative irradiation procedures. These are the cases with recurrences and metastases following surgery.

There is still another large group with incurable cancer considered at the first examination to be inoperable. These patients may be in excellent health and on the first symptom may be found by roentgen examination or by exploration to have an inoperable bronchogenic carcinoma or an inoperable malignant lesion of the gastrointestinal tract or of any of a number of other anatomic regions.

A third group have had the benefit of every virtue which surgery and irradiation could offer, but have failed in health and strength to such a rapid and marked degree that they have reached the terminal stages of their disease, for which nothing more than nursing care can be planned.

Inoperable cancer may be classified as "incurable," but nevertheless much may be accomplished by irradiation—by roentgen rays or radium or both. While it is true that palliation is the ultimate accomplishment in the majority of cases, it is likewise true that the good results cannot be classified on the basis of any statistical computations.

Unfortunately, the incidence of operability of cancer of all anatomic sites is exceedingly small; on an average, less than 25 per cent of all cancers are operable. The remaining preponderance of cancer patients must be referred to the radiologist for irradiation as against the alternative of doing nothing.

The care of the cancer patient becomes a problem that is largely radiological, rather than surgical. If one is to consider a possible 48 per cent surgical curability rate for carefully selected, so-called "early cancer of the breast," then half of the presumed early surgical cases revert to the radiologist. When we find that for all operable breast cancers, including cases with lymph-node involvement, the curability rate is

[1] Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–13, 1952.

only 35 per cent or less, then the problems and responsibilities of the radiologist become even more apparent.

Palliative effects are determined, not by tables and statistics, not by estimates of increased longevity cycles, but by an improvement in health and strength, gain in weight, relief of pain and discomfort, regression and complete healing of ulcerations, which may be large, ugly, fungating, and odoriferous, by lessening or complete control of hemorrhage, by the healing of metastatic bone lesions and repair of certain pathologic fractures, by the suppression of cough and dyspnea in lung and mediastinal metastases, by the retardation of localized and generalized metastases, and very often by the prolongation of life, as well as many other well known and universally acknowledged benefits to be obtained by irradiation.

Some of the results of irradiation may be only transient and of a short-lived character, but it is this idea and objective of a palliative effect that must be brought back into the spotlight of our therapy program and re-emphasized as one of the outstanding benefits to be obtained by irradiation, even though the records of good results cannot be shown in terms of statistics.

If radium and roentgen rays were to be acknowledged as of no actual value beyond ordinary palliative benefits, these agents for the treatment of advanced cancer should still be considered as having achieved and earned their rightful high place in the therapeutic armamentarium of medical progress and science. There are few radiologists who will not regard some of the most outstanding results of irradiation in their experience as of a palliative character.

The roles of the surgeon and radiologist in cancer therapy are now fairly well defined. Each specialty holds a recognized place in the treatment of reasonably early cases for which cure may be expected. Decisions as to operability must be individualized and modified according to training, experience, facilities, and equipment, but the regulation of the kind of treatment must rest finally on the special ability and skill of the surgeon or radiologist according to the particular anatomic site of cancer under consideration. But, as the total number of early cases of cancer at all anatomic sites for both surgical and irradiation management is probably less than 40 per cent, it is evident that the great majority of advanced cases remaining must receive some help as against the alternative of doing nothing.

The radiologist must learn from experience how to make modifications of dosage in planning irradiation procedures. The physical condition of the patient will very frequently not permit radical intensive plans of irradiation. It is often necessary to temporize as to the daily rate and total dosage so as to maintain the physical tolerance for treatment that may clean-up offensive ulcerations or even relieve pain from skeletal metastases.

Irradiation procedures should be carried out vigorously where the physical condition of the patient permits and where the anatomic site of involvement is one that will lend a hopeful outlook, as in intra-oral cancer and lesions about the larynx, breast, and cervix. There are other circumstances, also, that may justify intensive procedures.

On the other hand, one must bear in mind that the average cure rate of cancer, under the most favorable conditions, is not sufficiently great to warrant subjecting an individual for whom little can be expected to anything more than moderation in irradiation procedures or so-called temporizing treatment. This may be referred to as palliative therapy, but actually palliative therapy is sometimes achieved only with intensive procedures rather than lackadaisical or half-hearted methods. It is true that prolongation of life alone is not a measure of success of irradiation, but it is a possibility that may be attained and it is a gratifying accomplishment.

Should treatment procedures or palliation be strenuous and vigorous; should they be conservative and avoid risking the patient's comfort and aim to mitigate skin reactions; or should predetermined plan of

treatment and total dosage be modified so that biologic effects and benefits will be slight or impossible simply because the clinical character and extent of involvement are far beyond any reasonable chance of help or benefit as to cure? Should the aim be confined to relief of pain or should efforts be made only to heal sloughing or ulcerations? These are questions that the experience of the individual radiologist must decide. The problem of transportation in many instances is a handicap, and hospital management becomes necessary. Late radiation ulcers, radiation osteonecrosis, leukopenia, and anemia, which cannot always be avoided if strenuous treatment is to be carried out, may be distressing complications; but if cancer is to be controlled, these changes will probably not be of great importance.

Technical procedures for palliative irradition must be planned carefully. A routine so-called mathematical procedure cannot be followed. The treatment must be individualized. The patient with inoperable cancer must never be the object of careless or indifferent management. A special and greater effort is required, as well as a keener interest and enthusiasm than are generally manifested in the routine management of this hopeless disease.

Each patient is a problem according to age, physical condition, and extent of involvement. Marked differences for tumors in identical anatomic sites will occur. Other factors that govern results of irradiation are the daily rate of intensity, size of portals, the bed of the tumor, complicating infection, the host, endocrine conditions, and metabolic disturbances. Manifestations of sensitivity and resistance are so variable that clinical results of treatment are the final determining factors on this score. The designation of a tumor as possibly radiosensitive or radioresistant on histologic evidence is no criterion as to curability. Sections of different areas of the same tumor may show all of the features of various degrees of cellular differentiation. A radiosensitive lymphoblastoma is rarely curable, but a resistant cancer of the skin and lip can usually be cured by irradiation.

Our changing concepts regarding the skin dose are important considerations. The best technic is that which will deliver an effective lethal dose to the involved area and still preserve the integrity of the normal surrounding structures. It is now generally conceded that there is no specific benefit from any particular quality of irradiation. The biologic effect, whether the primary source is one of 1,000 kv. or of 100 kv., is of no practical or immediate importance. The quantitative difference may be adjusted by a cross-fire technic that will administer a depth dose of sufficient intensity to destroy tumor tissue.

The equipment that is available in practically every institution with ranges of 200 kv. can be considered to be an efficient weapon that will be suitable not only for the treatment of cancers that are ordinarily curable by irradiation but also for routine palliative measures. Supervoltages may have some advantages in certain inaccessible cancers or so-called "deep-seated" tumors. Much work has to be done to prove this superiority in the final clinical results. Irradiation from betatrons and synchrotrons is still of incompletely proved value. The revival of the so-called "grid" technic and recent experiences with a rotation technic seem to show some advantage in effecting greater depth-dose values. Further research along these lines is necessary, but the outlook is promising and these procedures should be of tremendous value because of their application in voltage ranges of about 200 kv.

Radiations from unstable radioisotopes are invaluable in research but, as far as experience has shown up to the present time, of limited value in cancer therapy except for carcinoma of the thyroid and in the control of pleural effusions and abdominal ascites. Recent experience with radiogold and radiocobalt has been encouraging.

Irradiation of the ovaries in cancer of the breast that has recurred after radical surgery in younger individuals who are still menstruating may be of a phenomenal

and sensational benefit. The results are variable, however, and the beneficial effects are generally of fairly short duration.

Hormone therapy in recurrent and metastatic cancer of the breast may produce a remarkable degree of subjective benefit as well as objective changes in the roentgenograms. We have limited the use of estrogens to soft-tissue metastases in persons of sixty years or more, while androgens have been confined to patients with bone metastases.

Radiation sickness is always a disturbing condition and, while there are no specific remedies, there are many supportive measures which will make the discomfort more tolerable and permit the completion of a predetermined plan of treatment.

It should be stated that many of the advanced incurable or so-called hopeless cases that end fatally present no special problems of management, yet there is a substantial majority whose problems are acute, and study of these may help to further the interest of those whose downward paths are less beset with thorns. Supportive medical measures and neurosurgical methods are always an important and at some time in the course of the disease a necessary adjunct. Even though in many instances life is not prolonged, the improved well-being and the relief of pain are a satisfaction and comfort which cannot be equaled in the management of many other hopeless diseases.

Home care or hospitalization is a problem dependent on financial circumstances and on the character and extent of disability and the anatomic site of involvement. Palliative surgery for obstruction, gastrostomies and tracheotomies, are emergency procedures for which institutional care is an immediate necessity.

Mild hypnotics and sedatives and narcotics in the terminal stages of cancer are useful, but these may be abused, and their use is a matter of common sense and experience. Antisyphilitic treatment concurrent with active irradiation, particularly with penicillin, should be done.

Relief of pain can be approached from many angles, including nerve block, but this can be best determined by the attending physician. Cordotomies and lobotomies should not be done except under very special circumstances. Complicating infection is serious, and the free use of antibiotics in conjunction with irradiation procedures is a very important consideration.

Methods of combating secondary anemia and radiation sickness, local measures to control sloughing ulcerations, and the use of irrigations in the presence of pelvic discharge, as well as in intra-oral cancer, are problems that must be met according to individual circumstances.

A physician should never allow a suffering individual to die in pain and neglect. If, however, treatment is to be instituted, whether it be by irradiation or by surgery, one must consider the question as to whether such measures may make the patient worse. If there is a chance that any kind of radical procedure may enhance his misery and suffering, then such treatment should never be instituted.

There arise strange circumstances and situations in the problem of managing a dying individual or one who knows that his future is not for long. The physician cannot always regulate the many intangible influences that may render the early cancer incurable and the advanced cancer uncontrollable. We should be equally cautious in guaranteeing a cure or dwelling on the futility of treatment. One of the many delicate and unpleasant situations in medicine is the problem of how and when and to whom the truth about the diagnosis of cancer and its prognosis is to be told. Courage and emotional stability are variable qualities in human beings.

While fear and ignorance conspire to perpetuate a false legend attaching to cancer the stigma of an incurable disease, and to cause the diagnosis to be accepted as a verdict of death, there are nevertheless very satisfactory and practical methods of approach to management and treatment that instill confidence and afford consolation and comfort as well as peace of mind and co-operation.

The problem of morale is one that has exhausted all controversies on this matter. Here again the ever-burning question of a "cure worse than the disease" enters into the picture. The patient is given reassurance with the frequent result that the seriousness of the disease is minimized or a word-picture of an apparent curable condition is portrayed. Special problems arise for each case. While the average individual is suspicious of his trouble, he generally does not want to be told frankly. He has nothing left but hope, and this false hope must be encouraged and extended under any circumstance. On the other hand, it is sometimes necessary and advisable to tell patients who have advanced cancer that they cannot recover.

A physician is often at his best when bringing comfort to the slowly dying, to persons with disease as yet incurable. The kind, sympathetic, and philosophic physician will always try not only to relieve physical pain but to lessen mental distress. This attitude of gentleness and sympathetic care not only gives the patient a lift but also radiates its comforting picture to his family and friends, whose anguish is often much greater than his own.

The matter of being frank with a patient as to the ultimate hopeless outlook is an important consideration for which there is no mathematical formula that will apply in all instances. A valuable guiding principle is one that must be personalized according to individual circumstances. As a rule, a patient senses the true problem much more keenly than one might suspect. Any attempt that can be made to soften the blow or to ameliorate his dilemma and anxiety is well repaid. There are occasions when it is wise not to disclose the true nature of the disease. The personality of the doctor plays a remarkable part in the tremendously important so-called doctor-patient relationship.

Matters of consultation should likewise be individualized. The patient should be safeguarded against harmful influences or confusing and conflicting circumstances. The family physician is a very important figure in this drama; counsel must be taken with him frequently, and he should be requested to carry out whatever supportive medication is considered advisable.

Relentless efforts to make an early diagnosis of cancer in a greater number of patients must be continued if greater progress in the management of this disease is to be achieved. The best interests of the cancer patient involve the combined efforts and skill of the family physician, surgeon, and radiologist. Bronchology, urology, gynecology, and pathology, as well as radiology, are special departments of importance for diagnostic accuracy.

Progress in radiation therapy is not retarded or overshadowed by the great advances and successes of surgery. Neither surgery nor irradiation is the final answer to the cancer problem, but thousands of cures and marvelous palliative benefits by each method are monumental records of medical achievement.

It is gratifying to note the interest and progress in the development of improved technical procedures of irradiation, particularly for the treatment of early or estimated curable cancer. Emphasis has very properly been directed to improving and recording results of so-called "cures" in terms of statistics for the early cases. Records of accomplishments are vital. They are a source of encouragement and an incentive for further improvement. It would be a disastrous kind of scientific vision that would ignore the importance of maintaining accurate statistical records for the probable curable group. An insatiable curiosity with respect to the possible good results to be achieved by irradiation in the early cases must be constantly and rigidly observed.

The priceless heritage of the radiologist is his opportunity as a physician to maintain a close relationship with individuals afflicted with disease and especially with cancer. This intimate contact calls into play all the potentialities of the healing art. His responsibilities are a constant reminder of the training and experience which he owes to the suffering individual. Not only

knowledge of the disease, its clinical and pathological characters, but also a special training and skill in the use of the ever-changing physical equipment for treatment and the newer, more meticulous methods of diagnosis are the weapons that must be used. The cancer patient must be the object of kindness, tenderness, and sympathy, as well as skill and understanding.

While it is true that irradiation has been attended by marvelous clinical results as well as actual cures, it is likewise true that the expectations of the public and even the medical profession far exceed the real possibilities. As the triumphs pass in review and the numerous processes of expediency and unprecedented paradoxes continue to reveal disappointing casualties from too much enthusiasm and wishful thinking, it is apparent that many of the problems of management will require psychological as well as actual physical assistance. The radiologist is a scientist but, above all, an artist, and he must weld together all of the manipulations of mental encouragement as well as physical aids that are known to medicine. The pent-up natural resources of the physician for psychotherapy are extraordinary.

The progress in radiology and especially in therapy has been in tune with the magnificent achievements of medicine. Unfortunately, the incidence of inoperable cancer is still too high, even overwhelming, at the time of diagnosis. Even apparently operable cases still show a heavy toll of recurrences. The medical profession and the public look to the radiologist for an expert opinion about methods of diagnosis, management, and treatment, as well as the problems of complication.

The management and treatment of cancer still remain predominantly a radiological problem.

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SUMARIO

La Asistencia de los Cancerosos Incurables

La atención y asistencia de los enfermos con cáncer incurable constituye predominantemente un problema radiológico. Los efectos paliativos se determinan, no estadísticamente, sino por factores tales como son el aumento de las fuerzas, el incremento de peso, el alivio del dolor y de la incomodidad, la cicatrización de las úlceras fétidas, el dominio de la hemorragia, la desaparición de las lesiones metastáticas en los huesos y la reparación de las fracturas patológicas, la supresión de la tos y de la disnea cuando existen metástasis pulmonares, el retardo de las metástasis localizadas y generalizadas y la prolongación de la vida. Aunque el radio y los rayos X no tuvieran más valor que la obtención de dichos resultados, todavía habría que concederles un puesto elevado en el arsenal terapéutico.

La terapéutica paliativa tiene que ser sumamente individualizada de acuerdo con el estado del enfermo, el asiento del tumor, etc. En ningunas circumstancias debe administrarse tratamiento que agudice los sufrimientos del paciente.

DISCUSSION

George Cooper, Jr., M.D. (Charlottesville, Va.): Dr. Widmann had a difficult but important assignment, which he has discharged with his expected efficiency. It is difficult to add to his comments. Still, I think we should pause a moment to remind ourselves that, with rare exceptions, however hopeless a *previously untreated* cancer patient's condition may seem, he should not be labeled "incurable" until an attempt has been made to treat him.

For instance, in 1927, a seven-year-old girl was seen in our Outpatient Department, with a grapefruit-sized mass in the right anterior thoracic wall, a biopsy of which revealed a Ewing's tumor. X-ray examination of the chest demonstrated that the tumor had arisen in the seventh rib and that the lungs were loaded with innumerable metastases. The child was cyanotic, cachectic, obviously near death, and was labeled "incurable" in the Clinic.

However, the distress of the parents was such, when they were told that there was nothing to do but take the child home to die, that, with great reluctance, an x-ray treatment was given. This was in 1927, and it is impossible to say now just what the dosage was.

One month later, the child walked into the Clinic. She had gained weight, had good color, and was in good spirits. Her tumor had regressed markedly, and a chest film showed complete disappearance of the pulmonary metastases. Another x-ray treatment was given, following which the tumor resolved entirely. That was in 1927. Since then, she has had no recurrence, and today is happily married and the mother of three children. Perhaps she cannot even yet be considered cured, but certainly the classification "incurable" was applied too hastily when she was first seen. You never know until you try.

I think Dr. Widmann might possibly have stressed the value of palliative surgery a little more strongly. Our surgical friends are often able to help by bypassing obstructions, excising ulcerative lesions resistant to irradiation, resecting tissues devitalized by radiation, and so forth.

The value of alternating or sometimes even combining therapeutic weapons should be mentioned in this discussion. Not too infrequently, a tumor which has become radioresistant may yield to nitrogen mustard or tri-ethyl-melamine or hormonal therapy and again become responsive to radiation; then, when that wears out, there may be response to one of the other therapeutic weapons. Also, when one method of treatment ceases to be useful, a change to something else renews the patient's hope and bolsters his morale.

In Dr. Widmann's paper there is a statement that "cordotomies and lobotomies should not be done except under special circumstances." I would like to amplify that a little bit. It would seem to me that, when confronted by intractable pain and/or a psychological reaction which is endangering the stability of the home, in a patient who has a life expectancy that must be measured in months rather than weeks or days, both the radiologist and the patient will profit from consultation with a sensible neurosurgeon—I deliberately insert the word "sensible." When he can offer hope of significant relief from pain or mental distress, his help should be accepted without hesitation.

A More Rapid Method of Isodose Analysis[1]

LEWIS L. HAAS, M.D.

THE DOSE IN THE center of a tumor is commonly denoted as tumor dose. Less frequently doses at one or more peripheral points of the tumor are also determined, *e.g.*, the points A and B in cervix cases.

In general, a complete isodose analysis of the whole irradiated body part is not performed. Such an analysis is limited to theoretical and scientific problems, and as Chamberlain advocates, to difficult and unusual cases (see Radiology **55:** 67–68, 1950). The procedure is admittedly time-consuming. Chamberlain has estimated the required time in individual cases as about eight hours. This is in close agreement with our experience on betatron cases, in which frequently 6 to 8, and sometimes 9 fields have been used, the time required being about seven hours.

The medical application of the betatron and of other high-energy sources has produced entirely new problems in treatment planning, since the physical dose distribution is quite different, and the exit dose is relatively large. The field selection, therefore, differs entirely from the pattern used in conventional roentgen therapy. Increased attention is necessary to avoid untoward reactions in healthy tissues and in especially radiosensitive organs far away from the tumor. For these reasons, precise and meticulous analysis of the doses absorbed in the tumor and healthy tissues appeared to be an essential requirement for clear insight into the new conditions, and for determining optimal treatment technic. The time problem, however, with a limited staff, prevented isodose analysis as frequently as was desirable.

With increasing experience, the necessity of routine isodose calculations became more and more obvious. It appeared desirable to work out a more rapid method which would enable us to perform an isodose analysis routinely in every individual case within reasonable time limits.

The following procedure proved to be a convenient method, inasmuch as it permits a complete isodose analysis in about one man-hour when large body parts, *e.g.*, the chest, are treated through more than four fields. The time is proportionately shorter when smaller body parts are analyzed, or fewer fields are used. The required one man-hour is already a feasible time for routine use, although one can expect that it will be further decreased by training and slight modifications.

The essence of the procedure is that the isodose curves (or scales) are replaced by a table of numerals (Fig. 1). These numerals are placed precisely 1 cm. apart. Each one signifies the dose at a point in the right lower corner of the numeral in percentage of the maximal dose. The tables are superimposed on the various treatment fields, and the numerals of the fields belonging to the same points are added. Experience has shown that the changes of dose are slow, and gradual. Therefore, it is sufficient to add only the doses of every second square centimeter (every 4 sq. cm.) in the greatest part of the irradiated area. Calculation is faster when the areas with two fields are counted first, followed by the areas with three fields, then with four fields. If the number of fields exceeds four, two copies of the body perimeter are drawn simultaneously with carbon paper, since it has been found that only four figures of four various fields may be added easily. The figures of the additional fields must be added to the first sum with the help of the second transparent copy of the cross section.

[1] From the Department of Radiology, University of Illinois College of Medicine, Chicago, Ill. Accepted for publication in September 1952.

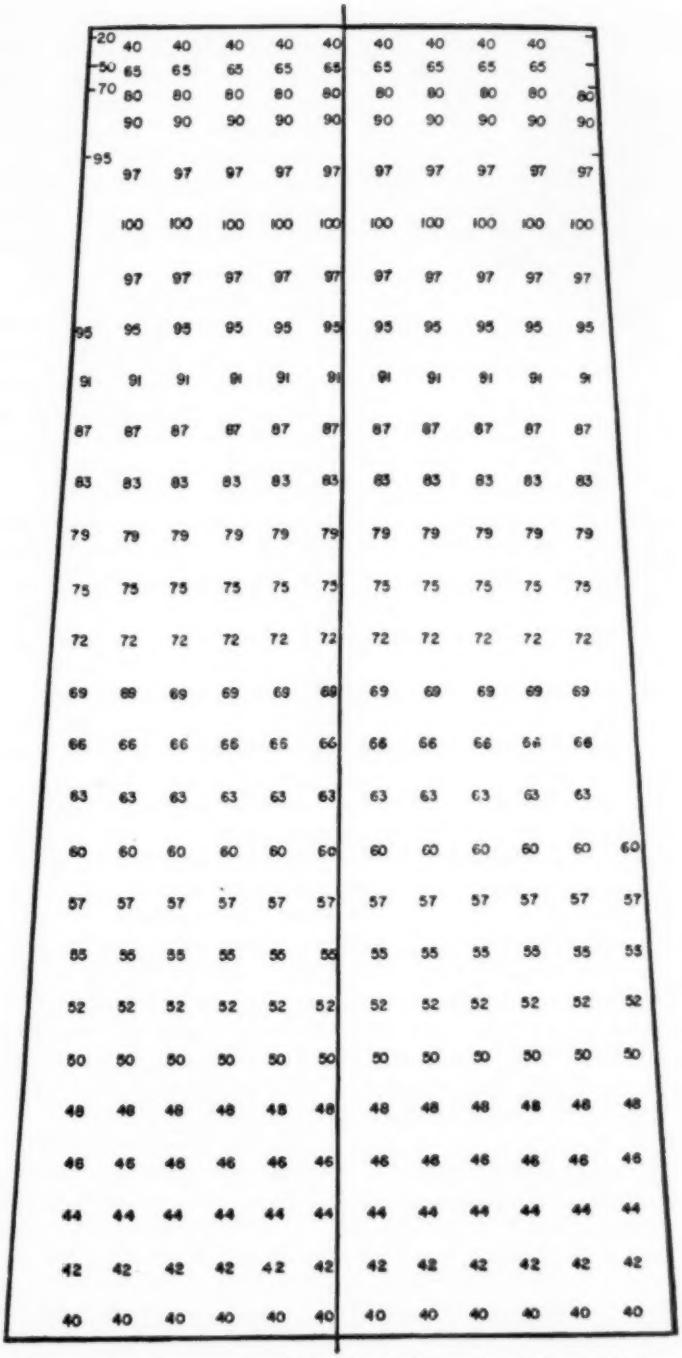

Fig. 1. Table of numerals replacing the isodose scale of 23-mev betatron x-rays for a 10-cm. diameter field.

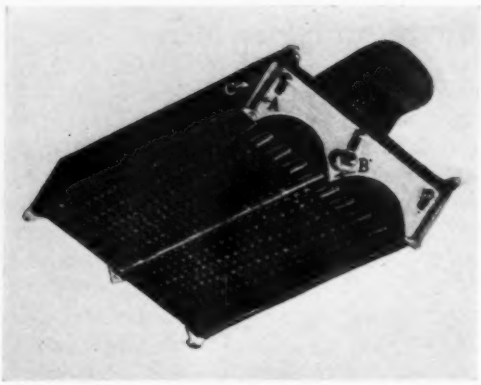

Fig. 2. Rubber stamp with the table of numerals, shown in Fig. 1. A. Spring structure elevating the stamp during positioning. B. Anterior pointer in the axis of the field. C. Lateral pointer to entrance line.

The procedure is facilitated by using a tracing paper ruled with square centimeter divisions, on which every second line is thicker, outlining squares of 4 sq. cm. (This paper was obtained from Bless Bindery, Philadelphia.) The fields may be superimposed in two ways:

(1) The table of numerals may be stamped on the tracing directly by a rubber stamp (Fig. 2). A simple spring structure positions the stamp in air above the tracing so that its entrance line and axis will be superimposed precisely on the respective lines of the tracing. Rapid positioning is facilitated by pointers attached to the stamp (B and C of Fig. 2).

(2) The table of numerals may be first stamped by the rubber stamp, or printed directly, on thin transparent cellophane sheets and cut to the shape and size of the actual beam. These stamped or printed transparent sheets are superimposed on the fields of the tracing. Thereafter, the numerals in every 1 or 4 sq. cm. are added, just as in the first method.

Individual choice determines the method to be used routinely. At first we preferred direct use of the rubber stamp, which permits a permanent check of the calculation. The cellophane stampings were used for preliminary orientation, selecting the useful fields, and surveying the safety of healthy tissues and radiosensitive organs. Later we found the transparent sheets to be more expedient for routine use. We had printed .005-in.-thick cellophane sheets with numerals in three colors to facilitate the additions. This also had an economical advantage, in that the cellophane stampings or prints may be cut to any field size smaller than the manufactured rubber stamps, since the depth-dose distribution of different field sizes does not differ practically over 5-cm. diameter size in the high-voltage range of the betatron.

One detail must be noted here. The method, like any other method of superimposition, is not satisfactory for calculation of the skin dose. On one hand, the dose of the betatron increases very fast from millimeter to millimeter in the superficial layer. On the other hand, the entrance field on the body surface is usually curved, and does not conform evenly to the flat entrance of the isodose curves, or scales. Therefore, the superficial layer must be omitted from the general additive isodose analysis to about 1 cm. depth. The skin dose must be calculated separately if necessary, adding together the entrance and exit doses reaching the skin segments in question.

Another accessory detail may be briefly mentioned. In the beginning, the body perimeter was traced in the usual way, using wire of lead or lead-tin alloy (solder wire), or aluminum. For rapid use thin steel wire covered with paper strips was tried. More recently we have found this in commercial production for florists, under the name of Twist Ems. The most reliable and pleasant procedure is the individual preparation of strips of fast-setting plaster (gypsona).

The described method of isodose analysis is also useful for conventional roentgen therapy, using properly constructed tables. The tables for low voltages must, of course, be shaped differently, since distribution is different and side-scattering is significant. Side-scattering in the high-energy range of our betatron is insignificant and can be neglected.

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SUMARIO

Método Más Rápido para el Análisis de Isodosis

Ofrécese un método cómodo y rápido para obtener un análisis completo de las isodosis. En el fondo, consiste el procedimiento en que las curvas o escalas de isodosis son suplantadas por una tabla de numerales que consigna la dosis en un porcentaje de la dosis máxima en un punto en la esquina inferior derecha del numeral. Las tablas se sobreponen a los campos terapéuticos, agregándose los numerales de los campos que corresponden a los mismos puntos.

Enteric Intussusception

A Case Report[1]

ALEXANDER GOULARD, JR., M.D.[2]

A REVIEW OF THE literature indicates that enteric intussusception in the adult is most frequently due to a tumor. In one large series of benign tumors of the small intestine, the incidence of intussusception was 17 per cent (7). In the largest series of carcinoma of the small bowel reported to date (2), intussusception occurred in 7.8 per cent. Relatively few cases associated with sarcoma have been recorded.

In the following case, the clinical history was typical, while the roentgen observations were unusual.

Mrs. P. K., a Negress aged 59, was admitted to the hospital on Feb. 16, 1950, complaining of flatulence and vomiting continuous for two days. Her past history revealed episodes of a similar nature in January, May, July, and November 1949 and in January 1950. On the last occasion, she had been seen in the Out-Patient Department, though at that time her acute symptoms had subsided. Vomiting always produced relief, though sometimes only temporarily. Eventually, however, each episode subsided spontaneously. The vomitus during the most recent attack was bile-stained, and there was associated pain radiating upward from the left lower quadrant of the abdomen. There had been a weight loss during the past year of 18 to 20 pounds.

The patient was poorly nourished and appeared acutely ill, frequently retching and regurgitating. Examination of the abdomen was reported as negative by one examiner, while another felt a definite mass in the left lower quadrant, soft and freely movable but not tender. The white blood cell count was 6,300, the red cell count 5,100,000, hemoglobin 15 gm. The stools were not examined for occult blood.

On Jan. 11, 1950, examination of the colon had been negative, though the preliminary film of the abdomen demonstrated a soft-tissue mass in the left side of the true pelvis, with smooth outlines. There was no evidence of obstruction at that time. Following admission, examination of the stomach (Feb. 16) showed tremendous dilatation and retention of secretions. The duodenum was likewise distended, and barium was seen to pass approximately 3 inches past the ligament of Treitz, at which point there was an asymmetrical narrowing of the barium column (Fig. 1). On pressure the narrowing became conical, almost straight, extending inferiorly for about 6 inches, after which the lumen of the bowel became large (Fig. 2). Not enough barium could be forced through to study this distal portion. The "mucosal pattern" of the narrowed area appeared surprisingly normal. A smooth palpable mass, freely movable, was palpated at this point by the fluoroscopist. The roentgen diagnosis was high intestinal obstruction of undetermined etiology.

Operation revealed a "retrograde intrussusception" of the jejunum, of about 1 foot, approximately 6 to 8 inches below the ligament of Treitz. A small nodule, 0.4 cm. in diameter, was found in the transverse mesocolon just above the ligament of Treitz. Following reduction of the intussusception, a palpable tumor 4 cm. in diameter was discovered within the lumen of the jejunum 12 inches below the ligament of Treitz. Examination of the abdominal contents was otherwise essentially negative.

The pathologist reported a sessile tumor 4 cm. in diameter: adenocarcinoma, Grade 2, with considerable colloid elements. The tumor invaded the thickness of the wall and was present in the lymphatics. The nodes showed no evidence of metastasis (Fig. 3).

DISCUSSION

This case demonstrates several important roentgenologic findings. On physical examination the patient was found to have a mass in the left lower quadrant, which was also demonstrated on a preliminary film, although at that time acute symptoms had subsided. Schatzki (8) describes the contrast of air and soft tissue in the intussusceptum and intussuscipiens as seen on the plain film in cases of obstructed intussusception. In the present case of intermittently complete obstruction with considerable hypertrophy of the proximal small bowel, this finding could not be demonstrated, perhaps because of excessive fluid proximal to the obstruction.

Upon oral administration of barium, an asymmetrical narrowing of the lumen was observed, representing the upper end of

[1] Accepted for publication in October 1952.

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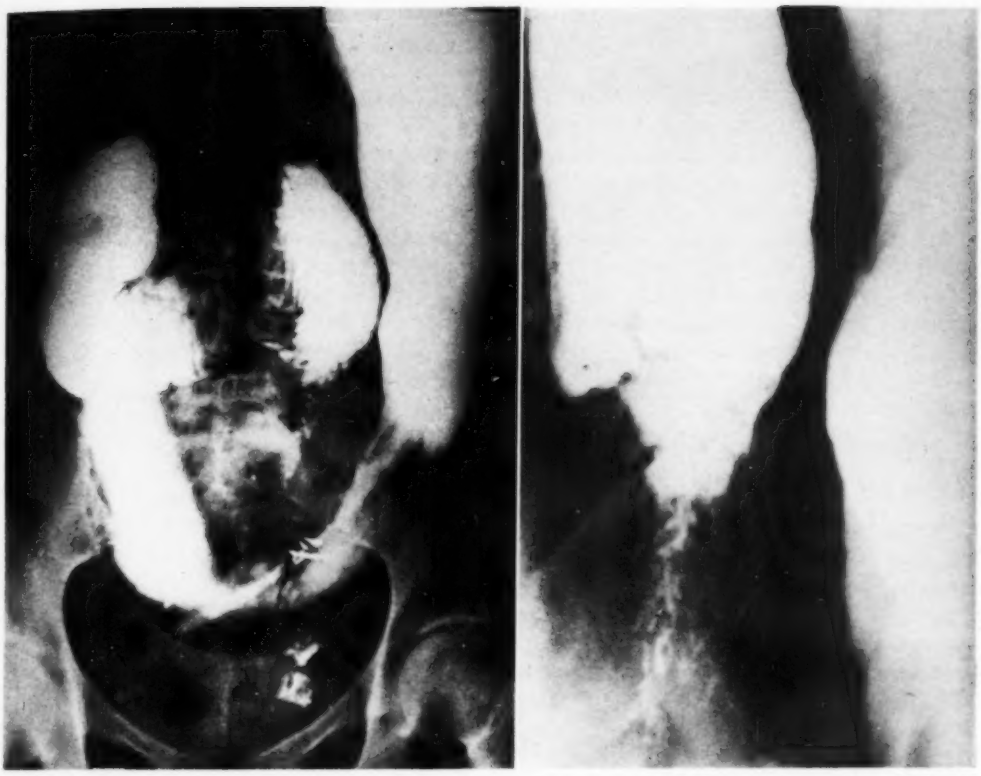

Fig. 1. There is marked dilatation proximal to the asymmetrical narrowing. The "mucosal pattern" is intact and the narrowed area is almost straight. Before pressure on the proximal segment, a cuff of bowel is seen indenting one side.

the cuff-like intussuscipiens on the mesenteric side (Fig. 1). This was due to ballooning of the dilated proximal small intestine over the intussuscipiens plus traction of the mesentery. When pressure was applied to the advancing barium column, the defect was obliterated and the narrowing became conical (Fig. 2).

In an effort to reproduce the case findings, grossly normal segments of small intestine obtained at autopsy, with the mesentery intact, were intussuscepted by means of corks attached at one point to the mucosal surface. The intussuscepted segments became sausage-shaped due to the tension of the mesentery. Furthermore, the intussusception was limited by the mesentery and beyond a certain point the intussusceptum could not be advanced distally because of this mesenteric tension. Though barium was forced into the intussusceptum, it was not possible to reproduce the defect on the mesenteric side caused by the intussuscipiens. This was due to the absence of the factor of obstruction with chronic hypertrophy and distention of the proximal gut. In fact, it was impossible to produce complete obstruction by intussuscepting these segments of devitalized gut, as ballooning of the proximal gut tended to reduce the intussusception. The "parrot's beak" deformity described by Castronovo (9), due to the pulling in of the mesentery by the intussusceptum, and lying between it and the intussuscipiens, was demonstrated (Fig. 4). It could be obliterated with pressure only when the intussusceptum was obstructed by a ligature. In the case presented, this "parrot's beak" defect was not well demonstrated because of ballooning and overhanging of the obstructed dilated

Fig. 2. After proximal pressure the unilateral defect is obliterated and the dilated, hypertrophied bowel has a smooth conical narrowing.

proximal segment. The length of the mesentery partially determined the length of the intussusception, and the thickness of the mesentery determined the amount of "parrot's beak" deformity.

It was found in the specimen studied that the actual point of invagination was the attachment of the corks to the wall of the gut. The approximation of the cork to the apex of the intussusceptum was directly proportional to the length of attaching suture. Adenomas and lipomas of the small intestine show the highest incidence of intussusception. These tumors are also the ones most prone to be pedunculated, presenting a freely movable intraluminal mass to be propelled by peristalsis. This is in accord with Raiford's concept that pedunculated or sessile tumors are the most prone to intussuscept, followed by intramural tumors which grow toward the lumen as the side of least resistance (5). All intussusceptions in Dundon's series of small intestinal tumors were due to pedunculated growths (6). Mucosal tumors infiltrating the wall and mesentery are malignant and are least prone to intussuscept.

A significant finding in enteric intussusception is the normal appearance of the mucosa of the intussusceptum, although there may be varying degrees of edema (3). Extrinsic lesions producing obstruction, particularly adhesions, will show a normal "mucosal pattern," but the bowel will be sharply angulated, while the "mucosal pattern" of the intussusception will form a shallow convexity, with an associated smooth mass. Little barium could be demonstrated distal to the intussusceptum in

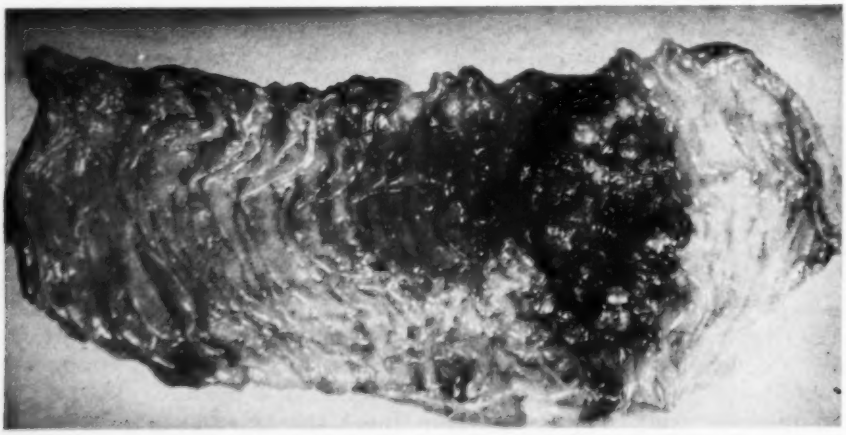

Fig. 3. Specimen of the sessile carcinoma which involved approximately one half of the circumference of the mucosal surface.

Fig. 4. A normal segment of small intestine intussuscepted by a cork sutured to the mucosal surface. Barium in and proximal to the intussusceptum produces the "parrot's beak" deformity due to pulling in of the mesentery between intussusceptum and intussuscipiens.

the case reported because of almost complete obstruction. In the specimens, spilling over demonstrated the typical "coiled spring" or "pincer" effect, due to the telescoping of the intussuscipiens over the intussusceptum. Whether this "coiled spring" or "pincer" effect is produced, depends on the amount of filling of the space between the intussusceptum and intussuscipiens.

Though the surgeon described the intussusception in our case as retrograde, we believe this term is misleading. The classic retrograde intussusception is jejunogastric, so well described and illustrated by McNamara (4). The mechanism of this type is similar to intussusception at the ileocecal junction, namely an invagination of a smaller flexible tube into a larger one at the point of abrupt change in size. By definition, retrograde means that the intussusceptum points proximally. The intussusceptum in the present case pointed distally, although the surgeon felt that the telescoping of the intussuscipiens over the lesion represented retrograde intussusception. It would seem to us more expedient simply to signify in which direction the intussusceptum points. Except for jejunogastric intussusception, no cases of acutal movement of the intussusceptum in an oral direction could be found in the literature.

CONCLUSIONS

Sessile or pedunculated tumors are most apt to produce small bowel intussusception in the adult. Complete obstruction is unusual, the intussusceptum normally being patent and the length of intussusception being limited by the mesentery. A case is reported and the gross and roentgenographic findings after oral administration of barium, with and without pressure, are correlated. These are compared with findings in normal devitalized non-obstructed segments of small bowel.

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SUMARIO

Invaginación Intestinal: Presentación de Un Caso

Los tumores sésiles o pediculados son los más susceptibles de producir invaginaciones intestinales en el adulto. La oclusión total es rara, siendo normalmente la invaginación permeable y limitando el mesenterio la extensión de la última.

Communícase un caso con típica historia clínica, pero con hallazgos clínicos extraños. Al administrarse oralmente bario, observóse una estrechez asimétrica de la luz intestinal, debida al extremo superior de la invaginación, a modo de manguito, en el lado del mesenterio. Esto se debía a inflación de la dilatada porción proximal del intestino sobre la intususcepción, unida a la tracción del mesenterio. Al aplicar presión a la columna de bario en marcha, se obliteró el defecto y el estrechamiento se volvió cónico.

La operación reveló una invaginación de unos 30 cm., del yeyuno, de 15 a 20 cm. más abajo del ligamento de Treitz. Dentro del yeyuno había un tumor sésil que resultó ser un adenocarcinoma.

Compáranse los hallazgos en este caso con los obtenidos en segmentos normales, desvitalizados y sin obstrucción, del intestino delgado, que fueron invaginados por medio de corchos adheridos en un punto de la superficie de la mucosa.

Spontaneous Fracture of the Femur in an Infant with a Large Occipital Meningocele[1]

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IN 1946, CAFFEY reported on "multiple fractures of the long bones of infants suffering from chronic subdural hematoma" and cited 4 or 5 similar cases previously recorded. In all of Caffey's 6 cases the subdural hematoma occurred without obvious cause, but he apparently favors the widely held theory that trauma is the factor responsible both for the fractures and the hematoma, although a history of injury is lacking in almost half of the patients investigated.

Caffey's 6 patients suffered a total of 23 fractures. While some of these might well have been caused by the same injury which was presumably responsible for the subdural hematoma, he denies this possibility in the majority, 17 of the fractures having appeared many weeks or months following the earliest clinical evidence of the hematoma and long after aspiration of sanguineous fluid from the subdural space. Any injury responsible for the fractures was either overlooked or, if observed, was denied. In only one instance did it seem probable that a fracture was already present when the child was first seen with the hematoma at the age of six weeks. Not only was there no history of injury to account for the fractures, but there was no clinical or roentgenological evidence to indicate any abnormality in the bones as a result of pre-existing systemic or skeletal disease.

Smith (3), in 1950, reported a further case of multiple fractures without a history of trauma in an infant in whom a subdural hematoma was subsequently discovered. In this instance there were several fractures in the skull as well as in the long bones. A thorough laboratory examination indicated definitely increased values of calcium and phosphorus and an elevated alkaline phosphatase such as is consistent with healing fractures. While trauma was not admitted by the parents of the child, the author suggests that the patient may have suffered injury during a long train journey, while under the care of sitters and relatives, who might well have been reluctant to admit the occurrence of an accident.

While Smith's explanation seems valid, it is, of course, not subject to proof. It seems remarkable that such extensive injuries could have been sustained without obvious changes requiring immediate medical attention. Furthermore, the edema at the sites of the different fractures developed at varying intervals, extending over several weeks, which seems to point to their occurrence at different times. It is, to be sure, possible that the subdural hematoma and the fractures were produced at the same time, but one cannot exclude the possibility that the fractures were of later appearance. Smith characterized the case as one in which fractures of the long bones aided in establishing the diagnosis of a subdural hematoma.

In December 1950, Lis and Frauenberger (4) published a similar case. Here again careful investigation failed to uncover a preceding trauma. It appears from their report that there was an interval of about eight weeks between the diagnosis of the subdural hematoma and the appearance of the fractures. There were fractures of 15 ribs, the left tibia, and the right acromion process. Three of the ribs showed two fractures, one of them three. Ample callus formation was ob-

[1] From the Department of Radiology (J. Munk, M.D., Director), "Rambam" (Government) Hospital, Haifa, Israel. Briefly presented before the Ninth Congress of the Israel Radiological Society, Tel-Aviv, March 19–21, 1952. Accepted for publication in September 1952.

served but, although the stage of its development differed in the various rib lesions, it was impossible to determine the time of occurrence of the individual fractures. In this patient as well, no signs of systemic or skeletal disease could be discovered.

In all the cases reported above, recovery eventually took place.

Because there is reasonable doubt that the only explanation of such unusually multiple fractures is trauma which was not admitted, the following case is reported as having some bearing on the etiology. While the case does not conform strictly to those cited above, it may, just because of its differences, serve to stimulate an investigation into the possibility that other factors may underlie these conditions.

CASE REPORT

A female infant, aged eleven months, was admitted to the Children's Department B (Dr. Bar Hai) of the Haifa Government Hospital in July 1951, with a diagnosis of acute meningitis and acute enteritis.

At examination on admission there was no evidence of meningitis, but an occipital meningocele about the size of an orange was present. The patient had suffered from a sanguineo-purulent diarrhea, and the temperature fluctuated, during the first week of observation, between 36.0 and 40.4 degrees C. Thereafter it subsided but rose again during the fifth week. The diarrhea continued throughout the entire illness.

Five weeks after admission a swelling in the proximal third of the left thigh was noticed, with tenderness in this area. Roentgen examination demonstrated a fracture of the femur, without any evidence of abnormal changes in the bone structure. The nursing staff denied any possibility of trauma as the cause of the lesion.

In contrast to the cases reviewed above, in all of which recovery took place, this child died a week later from a bilateral bronchopneumonia, affording an opportunity for histologic examination of the fractured bone. The pathologist (Dr. Gelley) reported normal bone tissue and callus formation surrounding the fracture. There was no evidence of abnormality in the bone structure. The report read, also: "An occipital meningocele, the size of a fist, is present, communicating with the cisterna. There is also an internal hydrocephalus and slight atrophy of the right lobe of the cerebellum."

DISCUSSION

The patient reported here was afflicted by a meningocele in contrast to the subdural hematoma present in the cases cited from the literature. She showed, furthermore, only one fracture as against the multiple fractures recorded by others. It should be pointed out, however, that not all the multiple fractures in the other cases occurred simultaneously and it could well have been that a later examination in this instance would have shown additional lesions; also that the development of pneumonia and subsequent death prevented a further check on the skeletal system. Unfortunately, we had no opportunity to make roentgenograms postmortem.

This case raises questions as to the possible etiological factors in multiple fractures such as have been described. It seems difficult to assume that in all the cases cited above—many of which showed fractures appearing at different times—not one of the persons responsible should have admitted the occurrence of trauma. One may hesitate to accept the opinion that trauma must always be suspected, for the following reasons:

1. A trauma which had caused such numerous bone injuries, especially at different times, would be difficult to conceal unless this were done intentionally; in such an event, it is unlikely that a physician would have been consulted later.
2. It is most unusual for trauma which produces rib fractures to skip some ribs. In the case of Lis and Frauenberger there were unfractured ribs between the fractured second and fourth, the fourth and sixth, and the seventh and eleventh ribs on the right; and between the first and fourth and the seventh and ninth on the left.

Our case is comparable to those of Caffey, Smith, and Lis and Frauenberger in that there was an unexplained fracture

presenting itself in a patient who was suffering from intracranial changes. In our case the intracranial lesion was most certainly not of traumatic origin, while in the previous instances the possibility of trauma exists. We wish to pose the question whether the changes could be similar in both conditions, *i.e.*, could a chronic subdural hematoma or an occipital meningocele be an etiological factor in the development of the fractures?

There being a reasonable doubt as to the cause of the fractures in all of the cases under discussion, it is important to observe that in our case, in which an injury to the skull is certainly not to be considered, there may be some relationship between the intracranial lesion and the fracture. In the same way, it is possible that the subdural hematomas previously reported may have created certain conditions conducive to fracture. It is interesting to note in this connection that the histologic and radiologic descriptions of spontaneous fractures in tabes dorsalis fit very well with the findings in the cases under discussion.

We do not propose to come forward with a new hypothesis concerning the etiology of fractures in patients who are suffering from intracranial disturbances. Yet this report should induce further investigation as to whether or not such a relationship may exist.

SUMMARY

An infant suffering from a large occipital meningocele acquired a fracture of the femur for which no cause could be established. The case is compared to the eight previously recorded cases of multiple fractures of the long bones in infants suffering from chronic subdural hematoma. While in all of these latter cases recovery ensued, our patient succumbed to pneumonia and postmortem findings are presented.

It is suggested that the assumption of an unknown injury is not an entirely satisfactory explanation for the fractures in such cases. The presence of intracranial changes in every instance suggests a possible common etiology.

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SUMARIO

Fractura Espontánea del Fémur en un Lactante con un Gran Meningocele Occipital

Un lactante que tenía un meningocele occipital greande experimentó una fractura del fémur, sin causa que pudiera establecerse. Compárase este caso con 8 casos comunicados anteriormente en que se asociaron fracturas múltiples de los huesos largos con hematoma subdural crónico. Aunque en todos estos últimos casos sobrevino la curación, el enfermito del caso descrito falleció de neumonía y fué posible ejecutar estudios autópsicos, los cuales revelaron tejido óseo normal y formación de callo alrededor de la fractura.

Sugiérese que la suposición de una lesión desconocida no representa una explicación del todo satisfactoria en esos casos. La presencia de alteraciones intracraneales en todos los casos sugiere la posibilidad de una etiología común. La investigación ulterior del problema parece conveniente.

Role of the Radiologist in Atomic Attack[1]

JUSTIN J. STEIN, M.D., ALBERT W. BELLAMY, PH.D., ANDREW H. DOWDY, M.D., STAFFORD L. WARREN, M.D.
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IN VIEW OF GREAT advances made in new weapons of war, the position of the radiologist is rapidly becoming more important. Because of his general medical training, supplemented by his knowledge of radioactive materials and of their inherent dangers, he will be of invaluable aid to both the military and civilian population.

For some time one of us (S.L.W.) has been advocating the necessity of a well organized radiological defense program for California. Shortly after the initial attack in Korea, Governor Earl Warren of this state took an active part in mobilizing civilian personnel into a well organized civil defense organization. In the beginning, radiological defense was placed under medical control, as a part of the medical plan. It was soon realized, however, that an effective radiological defense program would of necessity have to be large in personnel, that it would require specialized training plans and equipment, and would best function as a separate entity apart from medical activities.

In an actual or potential atomic conflict an understanding of both the immediate and long-range implications of atomic warfare in all its aspects is required. An organization capable of coping with such a disaster must be developed. Trained personnel and instruments essential to the detection and measurement of radioactivity and the rapid radiological assay of food, water, and air must be provided. Plans must be made for the rapid assembly and evaluation of information regarding personnel and exposures to radiation and decontamination during the acute phases of the disaster. Also the potential long-range hazards will be of great importance.

It can probably be assumed that radiation injury will account for approximately 15 to 20 per cent of casualties from an air explosion of an atomic bomb. The remaining 80 to 85 per cent will be made up of burns, fractures, lacerations, contusions, etc., either singly or in combination. Because of the terrific destructive effects of the atomic weapons and because so much publicity has been given to them, it is essential that accurate information be disseminated to the civilian population regarding them. If this is not done, a serious psychological problem will develop. Fear and ignorance are always conducive to disaster.

The Legislature in California appropriated money to cover the cost of equipping and maintaining personnel for radiological defense training and for the compilation of information. A Radiological Defense Plan was prepared as an annex to the overall State Civil Defense Plan. The outline of this annex is as follows:

I. Purpose
II. Basic policies and planning principles
III. Assumptions
    1. Assumed enemy actions
    2. Assumed results
IV. The essential problems
    1. Understanding of both the immediate and long-range implications of atomic warfare in all of its aspects
    2. Developing an adequate organization
    3. During acute phases of the disaster evaluation of the amount of radiation exposure and decontamination problems
V. Missions
    1. Pre-emergency
        (*a*) Training
        (*b*) Public information
        (*c*) Radiological intelligence
        (*d*) Meteorology
        (*e*) Instrumentation
        (*f*) Health physics
        (*g*) Special laboratories
    2. Alert phase

[1] From the University of California at Los Angeles, School of Medicine, Los Angeles, Calif. Presented at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7–12, 1952.

3. Post-attack, acute phases
4. Post-attack, chronic phases

VI. Staff organization and responsibilities

As previously stated, the radiologists, because of their special training in medicine and surgery as well as in radiology, are in a better position than others to understand the fundamentals of radiation contamination and radiation effects on the individual.

Because of anticipated confusion and disorganization which may immediately follow an enemy attack involving atomic weapons, mobile radiological laboratories have been developed. These mobile laboratories can move rapidly into involved areas and determine how much radioactivity is present and what precautions are necessary for civil defense personnel. They can conduct rapid examination of air, water, and other materials, and may function, also, as mobile support and headquarters for monitor squads.

The use of these mobile laboratories in the long-range chronic phase following the use of radioactive weapons will be equally important. The continued survey of soils, plants, and animals and the investigation of all radioactive materials affecting public welfare will be necessary. Such mobile units will also be invaluable in the training of field monitors.

The laboratories (Fig. 1) consist of a 7 × 12-ft. aluminum body 6 ft. 4 in. high, mounted on a 2-ton, dual rear, truck chassis. They contain radiological assay instruments and the necessary accessories for the rapid determination of radiation levels in air, water, soils, food, and other materials, as well as some equipment for related chemical work. They carry an engine-driven, 115-volt, 3,000 or 3,500-watt A.C. generator, a water storage tank, a butane gas tank, and communication equipment. The State of California has contracted for sixteen such units at an approximate cost of $15,000 each.

The personnel for operating a mobile laboratory under emergency conditions would include two radiological assay technicians, two helpers, one driver, and one communications man. The technicians should be men from organizations which can make frequent use of the equipment in the pursuit of their normal activities during the pre-emergency phase. Under a state of extreme emergency, control of the mobile laboratories passes automatically to the Radiological Services Division of the Civil Defense Organization.

In the event of a major disaster, all radiologists should contact their local civil defense organization at once and find out their assignment. They should help provide leadership in planning community disaster medical and health services. Current literature on civil defense, radiation defense, first aid, blood and blood derivatives, etc., should be studied. Groups of radiologists should request and plan for refresher courses of a half-day or day on atomic medicine, radiation dangers, prevention of radiation contamination, instrumentation, phenomenology of the atomic bomb, importance of meteorology, and other subjects. Each metropolitan group of radiologists should get together and decide on a plan for their area and integrate it into the statewide plan for civil defense. Full cooperation should be given to the training of teachers of physics, chemistry, science, and of others as monitors. It is probable that most radiologists will be working with their medical teams or in hospitals in their specialty. Those especially trained or interested in radiation therapy will be used to form evaluation teams, to be composed of one radiologist, one physicist, one soil scientist, one biologist, and one meteorologist. There will be an evaluation team at the state, region, city, and/or county levels.

During the first few hours or acute phase following attack with atomic and other weapons, considerable confusion will be present. Since most of the radiological defense personnel will be volunteers, there will be a short delay until they arrive at their posts. During this early phase it will be necessary for the protective services—law enforcement, fire, utilities, and engineering services—to have individuals in their groups trained and equipped with

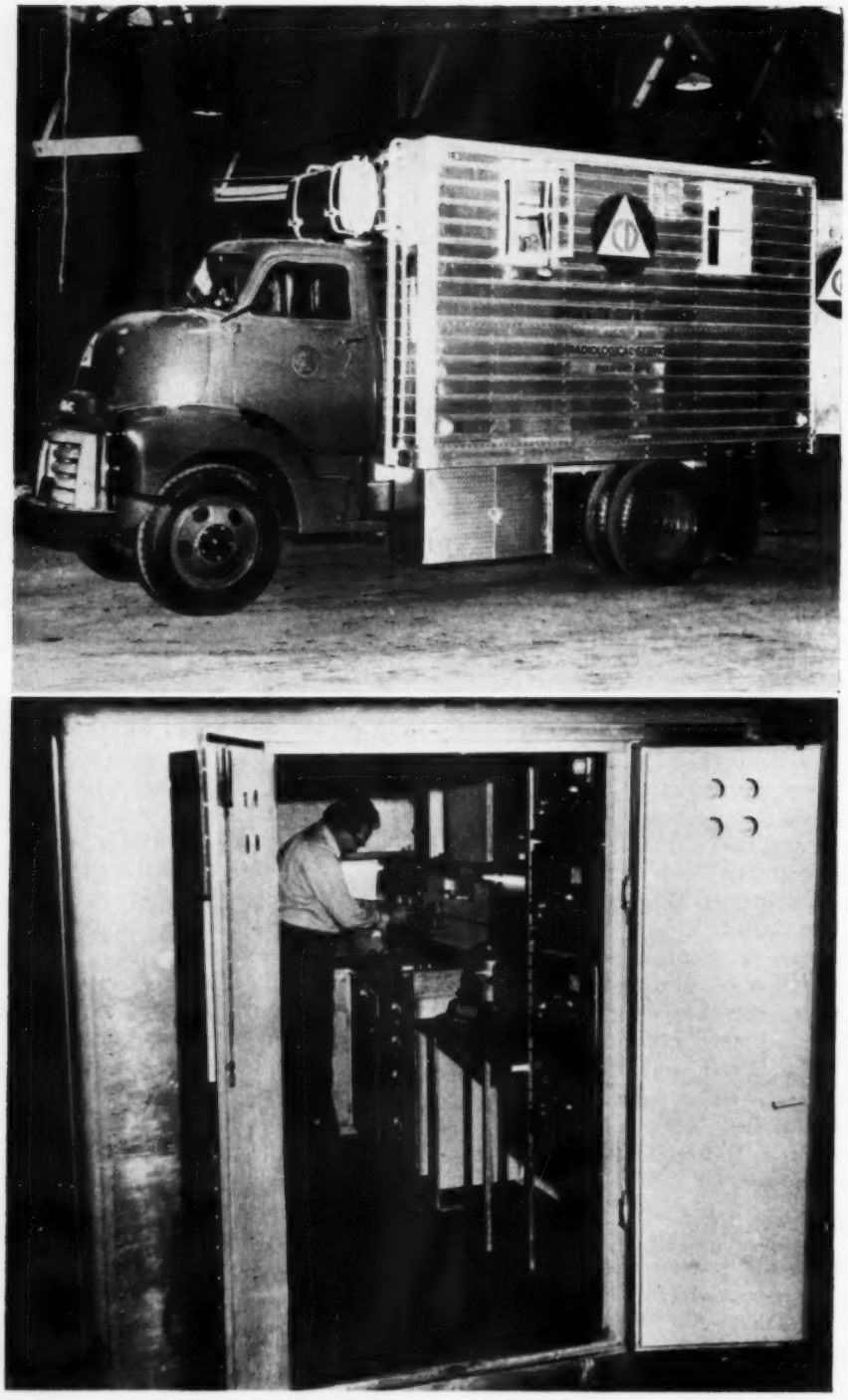

Fig. 1. Mobile radiological defense unit, exterior and interior views.

radiation detection instruments, the purpose being the making of one or two early reports of radiation levels immediately following the enemy attack and for their own protection. Members of these services, either in patrol cars or such installations as fire stations, police stations, utility depots and substations, are already deployed and equipped with their own communications. The necessity for making use of the protective services for some monitoring functions in the first several hours of a war-caused disaster arises out of difficulties and uncertainties about activating control centers and volunteer monitors within the first hours following an attack.

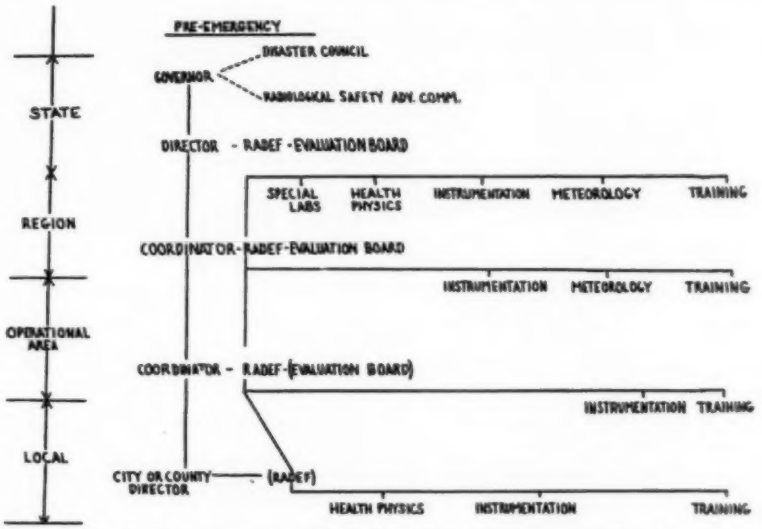

Fig. 2. Pre-emergency radiological civil defense plan for California.

During the acute phase the radiologist and the radiological services will be busy finding and plotting the levels of radioactivity in areas important for emergency operations, examining food, water, and air for radioactive contamination, and evaluating hazards to residents and operating personnel (Figs. 2 and 3).

As the chronic long-range phases of the disaster develop, the radiological services and the radiologists will become more and more occupied with the long and difficult job of making systematic radiological surveys of the entire state. Such surveys will include the examination for internally stored radioactivity of many kinds in plants and animals, especially those destined for human consumption. It is not known how long it will take for the levels of radioactivity finding its way into the soil, air, and water, to exert any appreciable effect on the health of man. The atomic weapons which are most likely to increase the seriousness of the long-range problems are those which detonate near, at, or below the surface of the ground or water. If rain accompanies or falls soon after such air bursts, it will materially enhance the radioactive fallout.

There is little information available for estimating the degree of danger presented by any level of radioactive materials in the soil. Radioactivity in the soil may enter the human body in several ways:

(1) By inhalation of material which makes up a part of the air-borne dust.
(2) By ingestion of foods that have radioactive particles adhering to their surfaces or mixed with them.
(3) By the drinking of water from reser-

voirs that are supplied from the run-off over contaminated water sheds.

(4) By ingestion of food plants that have absorbed radioactivity from contaminated soil. Once radioactivity has entered into chemical combination within the plant, it may be transferred to animals or returned to the soil when the plant decays. Or these materials may cycle from soil to plant and to man directly, or from plant to animals and thence to man by way of such animal products as milk, butter, eggs, soup bones, etc. Eventually all these materials return to the soil to start the cycle all over again.

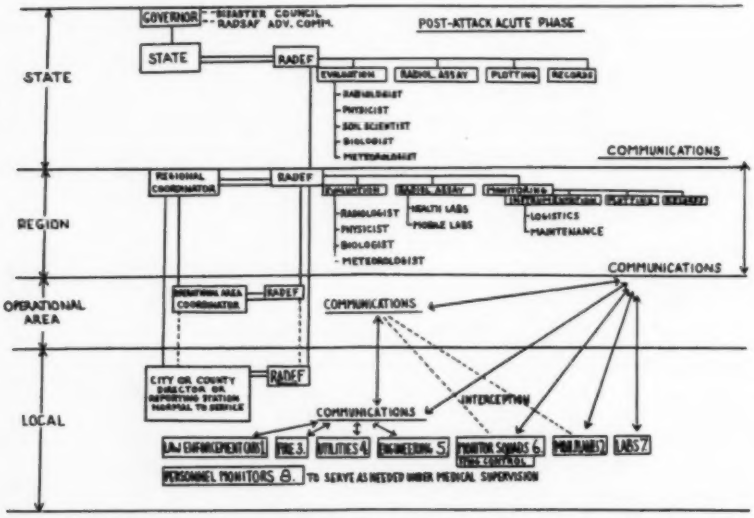

Fig. 3. Post-attack (acute phase) radiological civil defense plan for California. At the Communication centers there will be radiological evaluation boards.

Food in moisture-proof bags or dust-proof containers and canned food will be safe but should not be used until after decontamination of the exterior of the container. It is not safe to decontaminate food exposed to the open air. Bale (1) is of the opinion that, for continued peacetime consumption of water or food by the general population, it is wise to restrict combined alpha and beta activity to less than 10^{-13} curies per c.c. where medium or long-lived isotopes are involved. Distillation of water in properly designed evaporators was done at Bikini.

All articles of clothing which have become grossly contaminated should be placed in suitable containers and, when time permits, should be buried at sea.

All physicians, nurses, and hospital personnel who are treating casualties from contaminated areas should be carefully monitored daily and, when necessary, decontaminated frequently. Similar monitoring will be necessary for firemen, policemen, rescue workers, etc.

In some instances casualties caused by inhalation or ingestion of radioactive materials may be more severe than those from external radiation.

The atomic bomb tests in Nevada in 1951 afforded the Division of Radiological Services of the State of California, Office of Civil Defense, a remarkable opportunity to study the hazards that would arise from airborne radioactivity following attack. The importance of meteorological information in prognosticating the patterns of dissemination of radiological materials was quickly appreciated (2).

It has been estimated that receiving

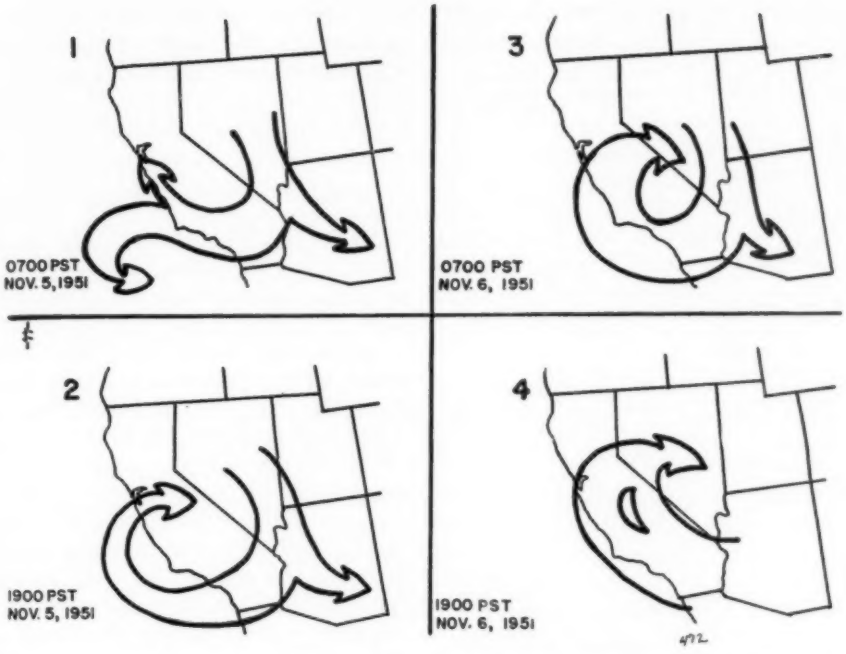

Fig. 4. Studies of the upper winds made at the same time on two successive days, illustrating the importance of meteorology in any radiological defense plan.

areas, etc., may be used for the first two days if radiation does not exceed 5 r per day. Also hospital emergency rooms and operating rooms should be evacuated after the first two days if the exposure rate is 5 r per day, or 1 r per day after the fifth day.

Suggested permissible exposures for monitors and others are as follows:

Acute period, 1st and 2nd days		Total
1st day	25 r	25 r
2nd day	10 r	10 r
Intermediate period, 3rd, 4th, and 5th days		
Per day	3.3 r	10 r
Later period, 6th through 56th day		
Per day	0.1 r	5 r
TOTAL		50.0 r

After the 56th day the present accepted tolerance level of 0.3 r/week applies.

For the decontamination of wounds, thorough irrigation may be done, but the main principle should be adequate débridement. Monitoring and partial decontamination of the less acute casualties can be done, but for those who are severely ill, with fractures, burns, etc., monitoring and decontamination may be detrimental. Persons with only minor injuries should have clothes, hands, hair, and feet monitored. If clothes are contaminated, they should be discarded into a proper container and the individuals given showers, with thorough cleansing of body folds, axillae, the skin under the nails, feet, and hair. Commercial detergents are very helpful. Severe trauma and shock should be handled as individual problems. Decontamination should continue where indicated to a minimum of 2 × peacetime permissible levels, *i.e.*, 1,000 millireps per week (surface measurements).

If necessary, titanium dioxide paste or a saturated solution of potassium permanganate may be applied to hands and feet, followed by a 5 per cent sodium bisulfite solution rinse.

TABLE I: SUMMARY OF CLINICAL SYMPTOMS OF RADIATION SICKNESS

Time after Exposure	Lethal Dose (600 r)	Median Lethal Dose (400 r)	Moderate Dose (300–100 r)
Immediately	Nausea and vomiting after 1 to 2 hours	Nausea and vomiting after 1 to 2 hours	
First week	No definite symptoms		
	Diarrhea Vomiting Inflammation of mouth and throat	No definite symptoms	
Second week	Fever Rapid emaciation Death (Mortality probably 100 per cent)	Beginning epilation Loss of appetite and general malaise	No definite symptoms
Third week		Fever Severe inflammation of mouth and throat	Epilation Loss of appetite and general malaise Sore throat Pallor Petechiae
Fourth week		Pallor Petechiae, diarrhea, and nosebleeds Rapid emaciation Death (Mortality probably 50 per cent)	Moderate emaciation (Recovery likely unless complicated by poor previous health and superimposed injuries or infections)

CLINICAL SYMPTOMS OF RADIATION SICKNESS

The symptomatology of radiation injury is not specific. It may be difficult to differentiate symptoms such as nausea and vomiting due to psychic disturbances from real radiation injury. Also individuals receiving the same amount of radiation exposure may react differently.

Damage to the lymphoid tissue is characteristic of radiation injury. Rapid lymphopenia is one of the few laboratory findings of value. Apparently one of the reasons for the hemorrhagic manifestations in the acute radiation syndrome is the decreased coagulability of the blood, believed to be caused by a circulating anticoagulant resembling heparin.

The clinical symptoms at intervals following exposure are summarized in Table I.

TREATMENT OF RADIATION INJURIES

All thermal burns should be treated as other types of burns, probably by some simplified method because of limited supplies.

All wounds which have been contaminated with radioactive material should be decontaminated by irrigation and by accepted surgical methods of débridement.

The treatment of radiation injury is symptomatic. There is no specific therapy. It is questionable whether any individual receiving 600 r body irradiation in a short space of time will survive, regardless of any method of treatment. The essential points in the treatment are as follows:

1. Absolute bed rest. Even for a month after the injury all physical activity must be limited.
2. Antibiotics such as Penicillin, Aureomycin, etc., for combating infections.
3. Intravenous feedings of glucose, proteins, and vitamins as indicated.
4. Blood transfusions to be given later; not in the beginning since it will be essential to conserve all blood bank supplies as much as possible. In the first few days blood transfusions will not be necessary for the radiation injured. Blood supplies will be in great demand for shock and surgical casualties. In the late radiation injury cases with petechiae and anemia the platelets are greatly diminished or absent, the blood fails to clot, and all wounds including needle puncture wounds ooze blood. There is no known method at the present time of checking the bleeding or producing clotting of the blood in these cases.

CONCLUSIONS

The fact that we are living in an age with the ever present possibility of widespread radioactivity of both an acute and chronic nature makes it imperative that we as radiologists learn as much as possible about atomic medicine. All radiologists should enter into and cooperate with any program for fact-finding, research, health, and decontamination, as affected by radioactive materials. Civil defense is here to stay, and the participation in it by all physicians, particularly radiologists, is a civic and patriotic duty.

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SUMARIO

El Papel del Radiólogo en los Ataques Atómicos

Por virtud de los grandes adelantos realizados en las nuevas armas de guerra, va tomando rápidamente mayor importancia el puesto del radiólogo. Debido a su adiestramiento médico general, complementado por el conocimiento de las substancias radioactivas y de los peligros inherentes en éstas, el radiólogo será un asesor insuperable.

Para cumplir su misión, tiene que estar al tanto de las obras de defensa pasiva en general y que formar parte de las comisiones asesoras de defensa radiológica, para la preparación de vigilantes y la educación del personal de defensa pasiva.

El diagnóstico y tratamiento de las lesiones por irradiación; la conservación de los repuestos de los bancos de sangre; la descontaminación de las heridas y de los lisiados en batalla o fuera de ella; los problemas del polvo esparcido por aviones; los problemas del agua potable y del alimento, todo esto corresponde a su dominio.

El radiólogo debe conocer a fondo y asumir las obligaciones que sobre él recaen durante el ataque atómico y antes y después del mismo.

Bosquéjase aquí el plan de defensa radiológica para el Estado de California y se describen los laboratorios movibles de radiología destinados a llevar a cabo los planes formulados.

DISCUSSION

Earl C. Corley, M.D. (Washington, D. C.): Dr. Stein's exposition of the planning for radiologic defense in California shows them to be far ahead of any such plans elsewhere with which I am familiar. If the extensive monitoring program which they have included in their set-up will function to reduce hysteria after an atomic explosion, it is all to the good, for unreasoned fear must be prevented if we are not to have as many casualties from panic as from bomb effects. The prompt appearance of defense teams after such an explosion will do much to allay fright.

It is my understanding that the air-burst bomb is the most destructive and the greatest casualty producer, but is the least likely to leave radioactive material in the target area. Assuming the air-burst bomb to be the most likely form of attack, the contusion and fracture cases will present an enormous problem to nearby surviving radiologists. Most surviving radiation victims will present such injuries as complications. Will there be facilities for diagnostic procedures on these thousands of casualties?

We must envision at such a time that, with the center of a city gutted, normal power supply will be completely disrupted or quite unreliable. It would seem worth while to plan individually and on a community basis for auxiliary sources of power. The civilian radiologist at such a time will find himself in comparable circumstances to the one in a

mobile field hospital, forced to work with portable equipment which is energized by power from any source obtainable, and overwhelmed with badly hurt patients.

The accumulated ferment concerning nuclear and radiation phenomena has apparently given rise in certain quarters, including governmental agencies, to a move for some kind of universal monitoring program. This is pictured as even reaching into all diagnostic laboratories for determinations. Whether or not this becomes an actuality, if radiologists are not to be led around by their noses, it behooves us actively and positively to enter into discussions and planning on national and community levels on this subject.

I appreciate the opportunity to participate in this program, and extend my congratulations to the essayist.

Iodine Wedge Filter for Roentgenographic Use[1]

RAÚL R. ALCÁNTARA CARBAJAL, M.D.

THE X-RAY BEAM emitted from the tube consists of photons of heterogeneous wave lengths, resulting in different penetrating power in the tissues of the body. This produces over-exposure of the less dense and less thick parts. On many occasions it is desirable to have a fairly uniform film density of the entire region examined, as for example in demonstration of the placenta, peripheral venography, and arteriography.

To overcome the difference in body density, various technics have been devised, such as the double exposure technic, dodging maneuvers, application of opaque material to the cassette, and interposition of paper between screen and film. None of these methods has proved completely satisfactory.

It has been known since the early days of radiation investigation that there exists a relationship between the absorption of various elements and their atomic weight. The use of compensatory filters of various elements interposed in a portion of the beam, in order to diminish the intensity of that portion, was first suggested by Pfahler (1) in 1906 on the basis of experimental work by Walter.

Fuchs (2) used barium paste as a filter in whole-body radiography. Vaughan *et al.* (3) and Calhoon (4) used a barium filter for demonstration of the placenta. Copper, thin lead, aluminum, and aluminum foil have all been tried for this purpose.

This paper presents the use of iodine as the absorbing material. It can be easily prepared; the materials required for the filter are readily available and inexpensive, and very satisfactory roentgenograms are obtained.

The materials necessary for making the filter are as follows:

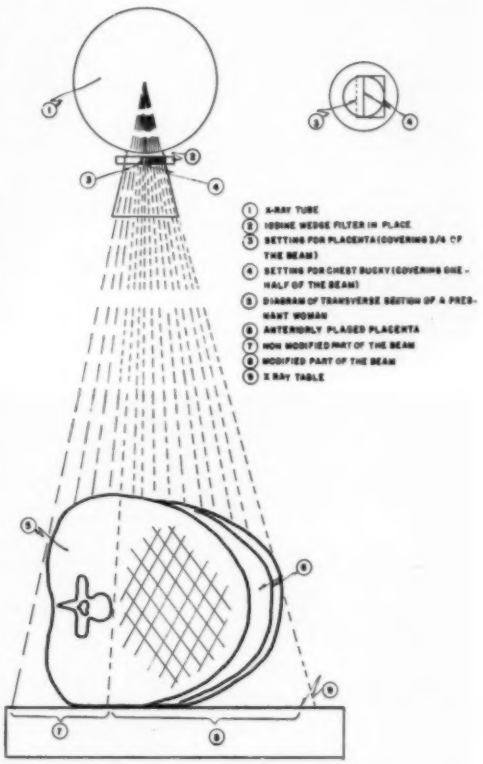

Fig. 1. Iodine wedge filter in place.

1. Concentrated tincture of iodine (Churchill's tincture of iodine, which contains 16 per cent iodine), 100 c.c. Diodrast and Neo-iopax were tried, but showed irregular crystallization when dried. Lipiodol was also inadequate, because of insufficient concentration of iodine, since the oil does not evaporate as does the alcohol in the tincture.
2. Blotting paper (100 lb. weight) cut in pieces of a length equal to that of the aluminum protecting filter of the x-ray tube, and wide enough to cover half the beam.

[1] From the Service of M. G. Wasch, M.D., Department of Radiology, Jewish Hospital of Brooklyn, N. Y. Accepted for publication in August 1952.

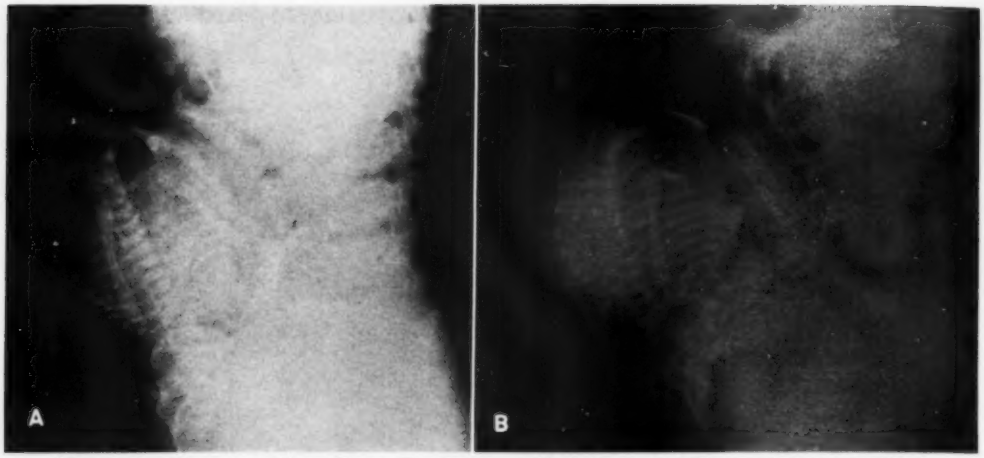

Fig. 2. A. Exposure without filter. B. Exposure with iodine wedge filter. Placenta visualized.

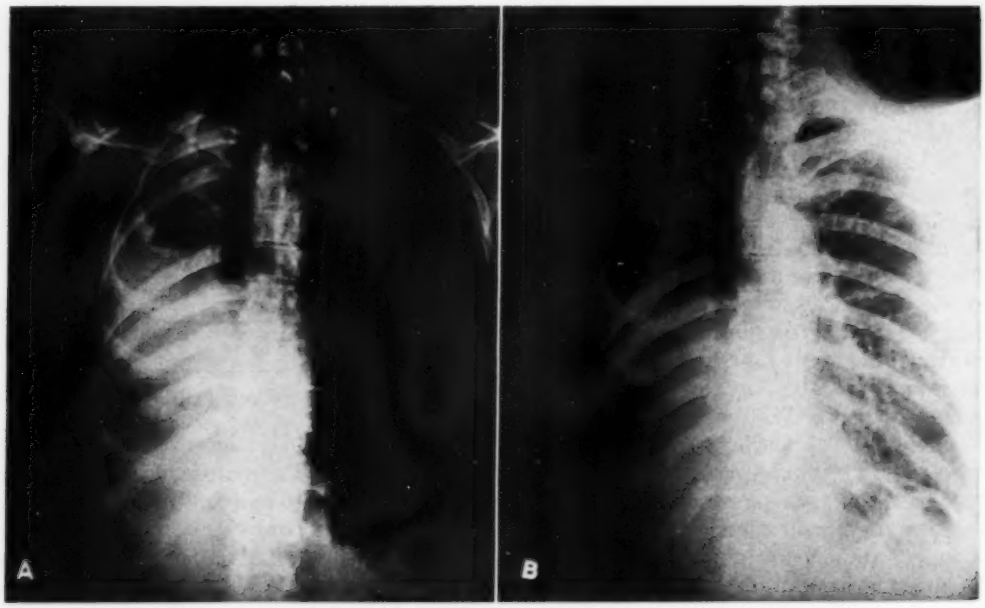

Fig. 3. A. Exposure with Bucky, no filter. B. Same technic, with iodine wedge filter.

3. Fixer (hypo solution), 20 to 30 c.c.
4. Scotch tape.

The directions for making the filter are as follows:

1. Soak the sheets of blotting paper in the tincture of iodine and let them dry.
2. Repeat this process several times to make sure of getting good impregnation of the blotting paper.
3. Let them dry and then soak them in a minimum amount of the ordinary hypo solution, just enough to reduce the iodine until the blotting paper returns to its original color.
4. Let them dry and then arrange the blotting papers in a staggered fashion so as to produce a wedge which covers about one-fourth of the diameter of the beam (Fig. 1).

5. Wrap them after trimming the edge of the filter opposite the wedge.

We have found that each thickness of blotting paper prepared in the above manner compensated for 2 kv. in the diagnostic range. For placenta visualization we use a filter containing six to eight blotting papers. Figures 2 and 3 demonstrate the results obtained with the use of this filter. For arteriography and venography of the lower extremities, with 14 × 34-inch cassette, the filter is placed so that the portion of beam exposing the feet is the most highly modified.

For general use, it is advisable to have filters made of four, six, and eight layers of blotting paper. Our filters made two years ago are still in use without apparent deterioration.

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SUMARIO

Filtro-Cuña de Yodo para Empleo en Radiografía

Para construir un filtro-cuña útil y poco costoso, se empaparon trozos de papel secante en tintura de yodo (16 por ciento de yodo), hasta impregnarlos bien. Luego se fijaron en solución de hiposulfito de sodio y se dispusieron en forma escalonada para formar una cuña que cubría aproximadamente la cuarta parte del diámetro del haz de rayos X.

Ese filtro ha resultado en particular útil en la placentografía, la arteriografía y la venografía.

Radiological Demonstration of the Zygomatic Arch[1]

DONALD D. McROBERTS, M.D.
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ONE OF THE USUALLY more difficult radiological technical problems is adequate demonstration of the zygomatic arch. This prominent facial structure is important to the plastic surgeon because of traumatic external deformities; to the ophthalmologist because trauma changes the orbital shape and eye levels, with resulting diplopia of serious nature; to the rhinologist because of injuries to the maxillary antrum; to the dentist because depression can interfere with the mandibular articulations and movement of the coronoid process and muscles of the jaw, producing bite deformities. The projections used by most technicians fail to produce views at these levels sufficiently measurable and comparable to give the radiologist and clinician a clear idea of the scope of the problem.

The zygomatic arch is composed of several bony parts. The main structure is the malar bone, which is a roughly rectangular plate. This is attached anteriorly to a projection from the maxillary bone, superiorly to a projection from the combined frontal and sphenoid bones, and posteriorly to a projection from the temporal bone. The relatively free malar borders between the bone attachments of the maxillary process and the frontosphenoid process form the lateral border and a portion of the inferior border of the orbit.

Unfortunately, injury of the zygomatic arch usually involves several of the bony parts and is quite often compounded into the maxillary sinus. The number of fractures and their location, the magnitude of the depressions in the arch, and the shifts of bone mass have to be shown by various technical positions, with the uninjured side serving as a model for the injured side. These views are preferably taken at right angles to each other to present the maximum deviations in the various planes. Three routine views, all of which show the opposite side for comparison, will demonstrate the arch in its entirety and will give measurable evidence of the amount of deformity involved.

The first view is obtained in the usual nose-chin position for the maxillary sinus study. The nose and chin rest on the table top over the mid-line of the table and cassette, with the mid-line sagittal section of the head vertical to the table top. The tube is placed with the central ray perpendicular to the table top and projecting through the floor of the orbits to pick up the inferior orbital ridges. This view is taken with a Bucky, with the average factors, for an average patient thickness of 23 cm., of 74 kv.p., 50 ma. sec., 40 in. focal skin distance. The film thus obtained outlines the inferior orbital ridge and will outline fractures in this area of the maxilla, demonstrating measurably any downward depression of the inferior orbital ridge, in addition to showing maxillary antral changes. The arch itself is not demonstrated, and both sides are shown for comparison in a single view.

The second view is the submentovertex projection, with the patient lying on the back, on the table top, with the head in hyperextension. This position is best achieved by the use of pillow props beneath the shoulders and mid-dorsal region so that the hyperextension can be exaggerated, as in the basal skull view. This view may even be taken with the patient sitting upright in a dental chair, with his head in hyperextension, the x-ray tube in his lap, and the film cassette held over his head. An excellent method is to have the patient lie with the head hanging over the edge of the table. The x-ray tube is brought to a position over the abdomen and the central ray projects from this position to the film held on top of the head at

[1] Accepted for publication in August 1952.

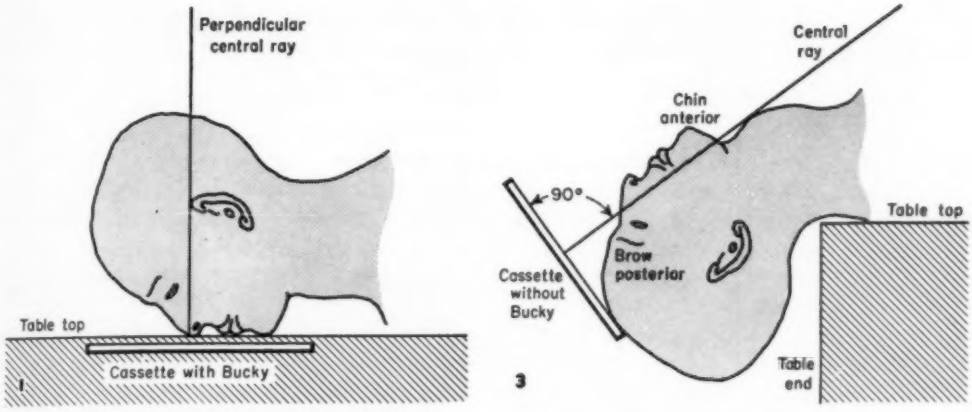

Fig. 1. Position for View 1: Nose-chin position. Factors: Distance 40 in., ma. sec. 50, kv.p. (23-cm. patient thickness) 74.
Fig. 3. Position for View 2. Submentovertex position. Factors: Distance 36 in., ma. sec. (no Bucky) 40, kv.p. (21 cm. patient thickness) 72.

Fig. 2. View 1.

Fig. 4. View 2.

right angles to the central ray. The latter follows the front plane of the maxillary portion of the face. *It is necessary to have the head in sufficient hyperextension so that the mandible is thrown anterior to the maxilla, and the brow posterior to the maxilla, in reference to this central ray.* This is the only difficult part of this projection. The mid-sagittal plane of the patient's head must be vertical and the film must be held at right angles to the central ray, which must project in the mid-line axis of the patient's body. For an average patient thickness of 21 cm. this view can be taken either without the Bucky, with the average factors 72 kv.p., 40 ma. sec., and a focal skin distance of 36 inches, or with the Bucky and average factors of 72 kv.p., 50 ma. sec., and 36 inches. The entire zygomatic arch is seen in clear outline, making possible a comparison of the amount of bone mass shift on the injured and the uninjured side in a single view. This view is practically at right angles with the first view and shows backward depression of the maxilla plus an excellent view of the wings of the arches for measurable demonstration of fractures and depressions in the arches, with the opposite side for comparison.

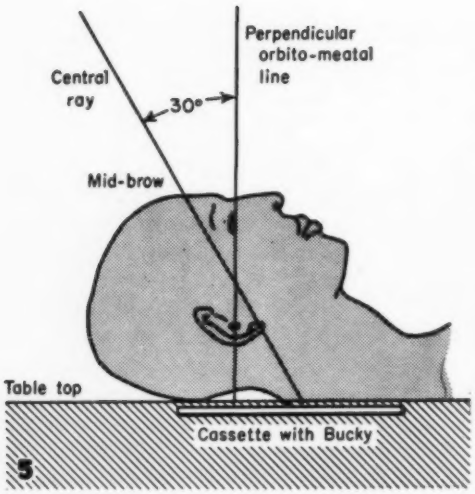

Fig. 5. Position for View 3. Forward occipital view. Factors: Distance 40 in., ma. sec. (Bucky) 50, kv.p. (20-cm. patient thickness) 70.

The third view is the usual occipital view of the skull except that the film is placed more caudally so that the temporomandibular joint area and the zygomatic arch are in the central plane. The patient lies on his back, on the table top, with the orbitomeatal line perpendicular to the table top and the mid-sagittal line over the center line of the table and cassette and perpendicular to the top of the table. The tube is tilted 30 degrees toward the feet, with the central ray extending through the midbrow instead of the midfrontal area as in the usual occipital skull view. The film is centered to the central ray. The exposure is made on the Bucky with the average factors of 70 kv.p., 50 ma. sec., and focal skin distance 40 in., for an average patient thickness of 20 cm. This view is an exaggeration view of the arch with the temporomandibular joint. An extra dividend is the condyle of the mandible, so

Fig. 6. View 3.

poorly shown on routine mandible films. Again both sides are seen in a single view for comparison.

These views are absolutely necessary and without peer in showing involvement and extent of movement of bone mass of the zygomatic arch.

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SUMARIO

Revelación Radiológica del Arco Cigomático

Descríbense tres vistas corrientes que revelarán por completo el arco cigomático y facilitarán radiografías mensurables en que aparecen ambos lados para comparación.

Son: (1) la habitual proyección nasomentoniana para el estudio del seno maxilar; (2) la proyección submentovértice, que muestra todo el arco netamente demarcado; y (3) una imagen occipital del cráneo, con la película colocada más caudalmente, de modo que quedan en el plano central la zona de la articulación temporomandibular y el arco cigomático.

Esas vistas se consideran indispensables para mostrar la invasión y la extensión de los movimientos de la masa ósea del arco cigomático.

Nucleoprotein Changes in the Gastrointestinal Tract Following Total-Body Roentgen Irradiation[1]

FREDERICK W. TILLOTSON, M.D., and SHIELDS WARREN, M.D.

THIS PAPER presents a cytochemical evaluation of the relative concentrations and a study of the interrelationships of the amounts of desoxyribonucleoprotein, ribonucleoprotein, and alkaline phosphatase in the destructive and reparative phases of the epithelium in the gastrointestinal tract of the rat following total-body irradiation by roentgen rays.

MATERIALS AND METHODS

Male albino rats of the Slonaker strain weighing 200 ± 20 gm. were used. They were maintained on a known daily amount of Purina Laboratory Chow,[2] allowed water *ad libitum*, and kept in groups of 3 in well ventilated wire cages.

The source of the roentgen radiation was a G. E. Maximar Therapy Unit with 223 kv., 10 ma., and 0.5 mm. copper and 1.0 mm. aluminum filtration. The rats were given a single dose of 700 r total-body irradiation in groups of 6 at a target-skin distance of 50 cm. The average dosage rate was 34.5 r per minute measured in air.

Groups of 3 rats each were killed with ether at intervals of one, two, five, ten, and fifteen hours and one, three, six, ten, fifteen, and twenty days after irradiation. Three non-irradiated animals were used as controls. It was noted that the irradiated animals voluntarily restricted their daily food intake by about 15 per cent the first five days after treatment. However, subsequent comparative histochemical studies of non-irradiated diet-restricted animals with normal controls showed no detectable differences. Immediately after death, four sections, from the mid third of the esophagus, stomach, and small and large intestine, respectively, of every animal were removed. Representative tissues were placed in three chemical fixatives (15): (*a*) Carnoy's mixture, (*b*) 80 per cent alcohol, (*c*) formol-Zenker. The fourth group of tissues was prepared by the freeze-drying dry-mounting technic of Holt (12). All tissues were imbedded in Tissuemat[3] with a melting point of 52–54° C. and cut to give sections 6 μ thick.

The following cytochemical technics were employed:

Nucleoprotein: The Feulgen method (15) was used for the demonstration of desoxyribonucleoprotein, henceforth called DNA. Material that gave a basophilic reaction following forty-five seconds exposure to a dilute solution of toluidine blue (0.5 per cent), and which could be digested out by prior incubation (8) (one hour at 37° C.) with 0.1 per cent ribonuclease,[4] buffered with McIlvaine buffer at *p*H 6.8, was considered ribonucleoprotein, designated as RNA. Controls were simultaneously incubated for a similar time in the buffer, at *p*H 6.8, without the enzyme. Tissues fixed in Carnoy's mixture and prepared by the freeze-drying method were studied.

Enzymes: Alkaline phosphatase reactions were done by the method of Gomori (11). Care was taken to use the same incubation time of thirty minutes on all tissues and to observe time limits in the procedure as recommended by Moe (17). Diffusion of the enzyme was considered minimal (18, 7, 26).

Studies of the cytochemical reactions were limited to cells in the interphase, with intact nuclei, and in a similar plane of section. In the esophagus, cells of the basal layer of the epithelium were considered; in the stomach, the zymogenic cells (16) of the basal one-fourth of the epithelium; in the small and large intestine, non-goblet columnar cells near the bases of the crypts.

The evaluations of the cytochemical changes, that is, the estimated amounts of

[1] From the Cancer Research Institute, New England Deaconess Hospital, Boston, Mass. This work was done under U. S. Atomic Energy Commission Contract AT(30-1)-901 with the New England Deaconess Hospital. Accepted for publication in September 1952.

[2] Purina Laboratory Chow, Ralston Purina Company, St. Louis, Mo.

[3] Fisher Scientific Company, Pittsburgh, Penna.

[4] Armour Laboratories, Chicago, Ill.

TABLE I: CYTOCHEMICAL CHANGES IN THE ESOPHAGUS FOLLOWING ROENTGEN IRRADIATION*

Time after Irradiation	DNA	RNA		Alkaline Phosphatase		
	Nucleus	Cytoplasm	Nucleolus	Cytoplasm	Nucleus	Nucleolus
Control	3	2	1	1	1	3
1 hr.	3	2	1	1	1	3
2 hr.	3	2	1	1	1	3
5 hr.	3	2	1	1	1	3
10 hr.	2	2	1	1	1	3
15 hr.	2	2	1	1	1	3
1 day	3	2	1	1	1	4
3 days	4	2	1	1	1	3
6 days	4	2	1	1	1	3
10 days	3	2	1	1	1	3
15 days	3	2	1	1	1	3
20 days	3	2	1	1	1	3

* Evaluation of cytochemical changes 0–5. Basal cells of epithelium. Each figure represents the estimated average value resulting from the observations of 500 to 600 cells.

TABLE II: CYTOCHEMICAL CHANGES IN THE STOMACH FOLLOWING ROENTGEN IRRADIATION*

Time after Irradiation	DNA	RNA		Alkaline Phosphatase		
	Nucleus	Cytoplasm	Nucleolus	Cytoplasm	Nucleus	Nucleolus
Control	3	5	2	3	1	2
1 hr.	3	5	2	3	1	2
2 hr.	3	5	2	3	1	2
5 hr.	2	4	1	3	1	2
10 hr.	2	4	2	2	1	2
15 hr.	2	4	2	3	1	2
1 day	2	4	2	3	1	2
3 days	3	5	2	3	1	2
6 days	3	5	2	3	1	2
10 days	3	5	2	3	1	2
15 days	3	5	2	3	1	2
20 days	3	5	2	3	1	2

* Evaluation of cytochemical changes 0–5. Zymogenic cells of gastric glands. Each figure represents the estimated average value resulting from the observations of 500 to 600 cells.

material and intensity of the staining reaction, were made on a numerical basis ranging from 0 to 5.

Finally, after the previous evaluations had been completed, ultraviolet light absorption studies were made on the small intestine. Control sections and those taken at intervals of five hours, one and ten days following irradiation were chosen because, qualitatively, they had shown the most pronounced cytochemical alterations. Frozen-dried, unstained preparations, 3 μ thick, were mounted in glycerol between Vycor[5] slides and cover-slips and sealed with paraffin. Eight to ten fields near the bases of the intestinal crypts, comparable to those previously studied, were photomicrographed at 248, 263, and 280 mμ on the Color-Translating Ultraviolet Microscope (21) recently developed at the Polaroid Corporation. Exposures were adjusted to give the negatives a density range from which comparable quantitative absorption data could be obtained. This was possible since, within certain limits of the latitude of the film, these densities were directly proportional to the logarithms of the exposure times.

[5] Corning Glass Works, Corning, N. Y.

OBSERVATIONS

The following descriptions and evaluations pertain only to the frozen-dehydrated dry-mounted tissues, since they were more intensely and uniformly stained and the foci of staining reactions were more sharply defined.

Esophagus (Table I): The average non-irradiated basal cell had an oval or slightly elongated nucleus, intermediate in size, which contained finely stippled, dark-colored chromatin. The DNA content was rated 3. The cytoplasmic RNA was

TABLE III: CYTOCHEMICAL CHANGES IN THE SMALL INTESTINE FOLLOWING ROENTGEN IRRADIATION*

Time after Irradiation	DNA	RNA		Alkaline Phosphatase		
	Nucleus	Cytoplasm	Nucleolus	Cytoplasm	Nucleus	Nucleolus
Control	4	4	1	1	1	4
1 hr.	3	3	1	1	1	3
2 hr.	2	2	1	1	1	3
5 hr.	1	1	1–0	1	1	3
10 hr.	2	1	2	1	2	4
15 hr.	2	2	2	1	2	4
1 day	2	3	2	1	2	5
3 days	4	4	3	1	2	5
6 days	5	5	3	1	1	4
10 days	5	5	2	1	1	4
15 days	4	4	1	1	1	4
20 days	4	4	1	1	1	4

* Evaluation of cytochemical changes 0–5. Columnar cells of the regenerative regions of the crypts. Each figure represents the estimated average value resulting from the observations of 500 to 600 cells.

scant and was rated 2. Nucleolar RNA could be evaluated only indirectly (after digestion) as a small clear space. It was rated 1. Nucleolar alkaline phosphatase, rated 3, appeared as a dark brown or black rounded mass, well demarcated. Nuclear and cytoplasmic alkaline phosphatase appeared as scant dark brown or black minute granules; each was rated 1.

After roentgen irradiation, no changes were detected until ten hours had elapsed. At that time, there was slight rounding of the nuclei and a decrease of stainable DNA. At one day, there was reappearance of finely stippled dark-colored chromatin. At three to six days, there was an overproduction of DNA, rated 4, and manifested by coarse, darkly stained chromatin material. No changes could be detected in cytoplasmic and nucleolar RNA. Alkaline phosphatase was unchanged except for a slight increase in the nucleolus on the first day after irradiation.

Stomach (Table II): The non-irradiated zymogenic cell had an oval or round nucleus with finely stippled chromatin and a DNA estimated concentration of 2. The RNA estimated concentration of the abundant well defined cytoplasm was rated at the maximum figure, 5. Nucleolar RNA was more abundant than in the esophageal cells and was rated 2. Alkaline phosphatase appeared as fine dark brown granules in the cytoplasm, rated 3, and was well concentrated in the nucleolus, 2. The enzyme was barely apparent in the nucleus, 1.

These cells proved rather inert in their cytochemical reactions to roentgen irradiation. There was only a slight decrease of DNA and of cytoplasmic RNA between the fifth hour and the third day.

Small Intestine (Table III): A characteristic non-irradiated columnar cell near the bottom of the crypts of Lieberkühn had a moderately large, elongate nucleus containing scattered small, irregularly shaped, dark-stained chromatin particles. Additional particles lay around the peripheries of the nucleus and nucleolus (9, 20). The chromatin contained large apparent concentrations of DNA (Fig. 1), rated 4. Cytoplasmic RNA was abundant, 4, and finely granular (Figs. 9 and 10). Only slight apparent concentrations could be detected in the nucleolus (Fig. 9). Ultraviolet photomicrographs of the cells substantiated these findings. They showed regions of light absorption in the nucleus and cytoplasm which corresponded to the material stained by toluidine blue and the Feulgen method (Fig. 5). Alkaline phosphatase, high in the nucleolus, was rated 4; it appeared as a rounded black mass (Fig. 15). Nuclear and cytoplasmic alkaline phosphatase appeared as fine, scattered, dark brown granules.

Following roentgen irradiation, cytochemical changes in the cells of the small intestine were marked and well defined. One hour after irradiation, the nuclei were more nearly round; the chromatin particles were less well defined and less intensely stained. The DNA estimated concentration was rated 3. At five hours, surviving

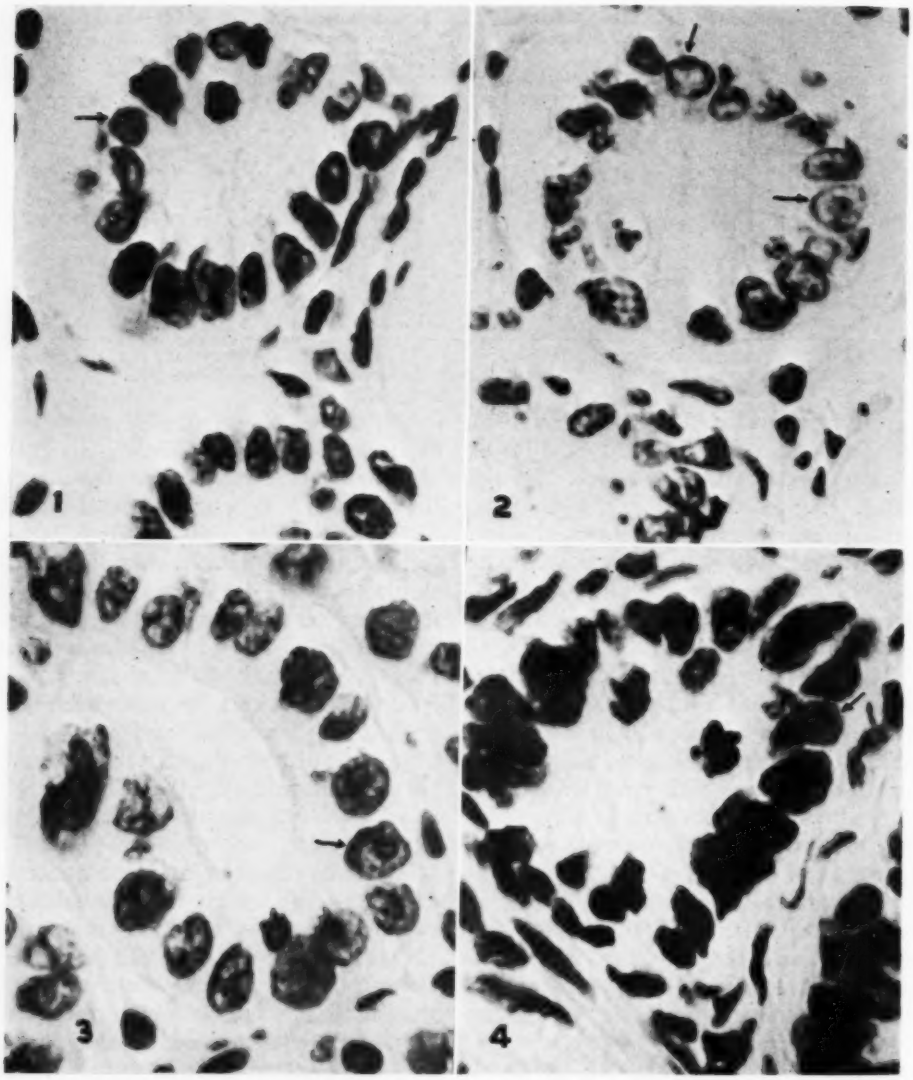
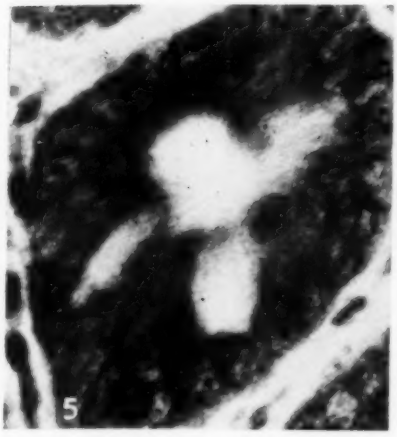
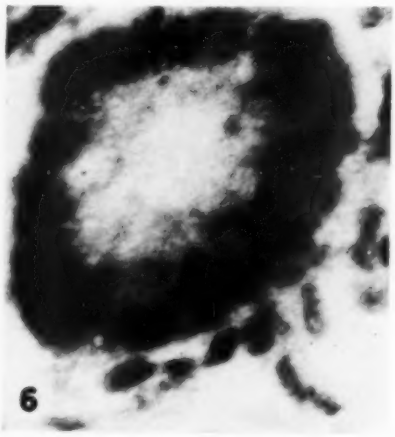
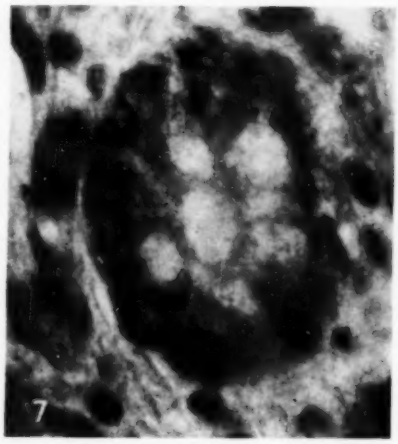


Fig. 1. Small intestine, normal non-irradiated control. DNA content of nucleus appears as dispersed particles and around the peripheries of nucleus and nucleolus. Feulgen stain. ×1000.
Fig. 2. Small intestine, five hours after irradiation. Intact nuclei are nearly depleted of DNA. Some exists around the peripheries of nucleus and nucleolus. Feulgen stain. ×1000.
Fig. 3. Small intestine, one day after irradiation. Large irregularly shaped nuclei are beginning to accumulate chromatin particles. Note large nucleoli. Feulgen stain. ×1000.
Fig. 4. Small intestine, ten days after irradiation. Moderate diminution in size of nucleus and nucleolus. Abundant, large, dark-stained chromatin particles. Feulgen stain. ×1000.

cells showed traces of lightly stained DNA concentrated around the peripheries of the nuclei and nucleoli (Fig. 2). In marked contrast to these staining reactions, however, the nuclei and adjacent portions of cytoplasm showed an intense and nearly homogeneous ultraviolet light absorption (Fig. 6). This absorption was present only at 263 mμ and was minimal or absent at 248 and 280 mμ. By ten hours, the nuclei showed a few small well defined DNA particles. By the first day, the







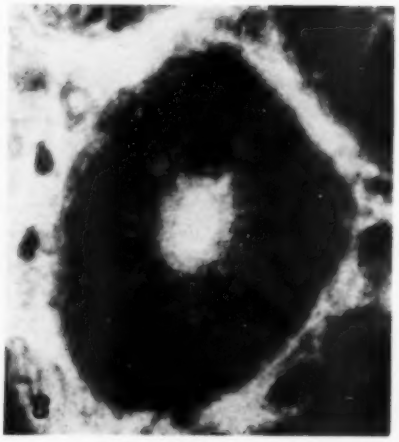


Fig. 5. Small intestine, normal non-irradiated control. Ultraviolet light (263 mμ). Four times basic exposure. Note regions of light absorption corresponding to that material stained by toluidine blue and the Feulgen method. ×1000.

Fig. 6. Small intestine, five hours after irradiation. Ultraviolet light (263 mμ). Eight times basic exposure. There is an intense and nearly homogeneous light absorption in regions corresponding to nucleus and adjacent cytoplasm. Compare with Feulgen and toluidine blue stains. ×1000.

Fig. 7. Small intestine, one day after irradiation. Ultraviolet light (263 mμ). Basic exposure. Reappearance of foci of light absorption in nucleus and cytoplasm. ×1000.

Fig. 8. Small intestine, ten days after irradiation. Ultraviolet light (263 mμ). Eight times basic exposure. There are now regions of intense light absorption in the nucleus and cytoplasm corresponding to that material stained by toluidine blue and the Feulgen method. ×1000.

nuclei were larger and more irregular than those in the controls (Fig. 3). They contained coarse, widely distributed, lightly stained chromatin particles. Corresponding regions in the unstained preparations absorbed only moderate amounts of ultraviolet light (Fig. 7). At six and ten days the enlarged nuclei contained dark-stained (Fig. 4), intensely ultraviolet-light-absorbing (Fig. 8), coarse chromatin particles. The DNA estimated concentration was rated 5. After ten days, the nuclei were similar to those of the controls. Cytoplasmic and nucleolar RNA estimated concentration showed similar changes at nearly the same time intervals as those of DNA (Figs. 11–14).

Nucleolar alkaline phosphatase de-

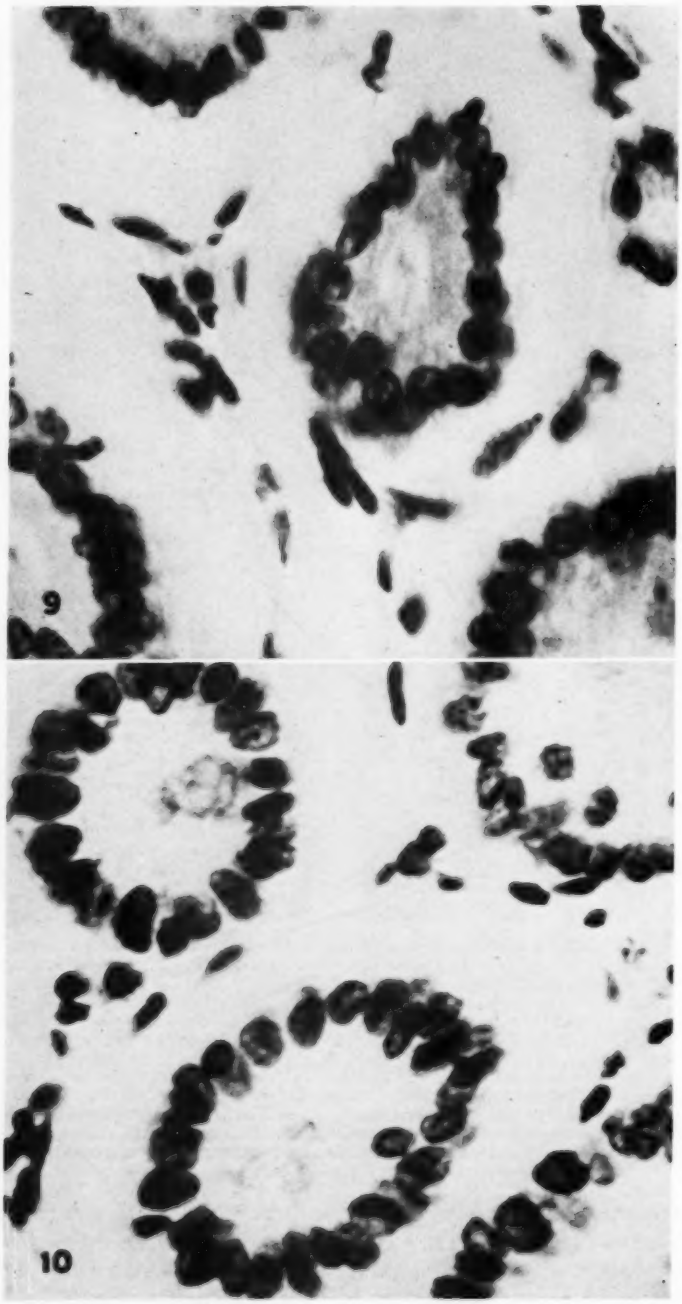
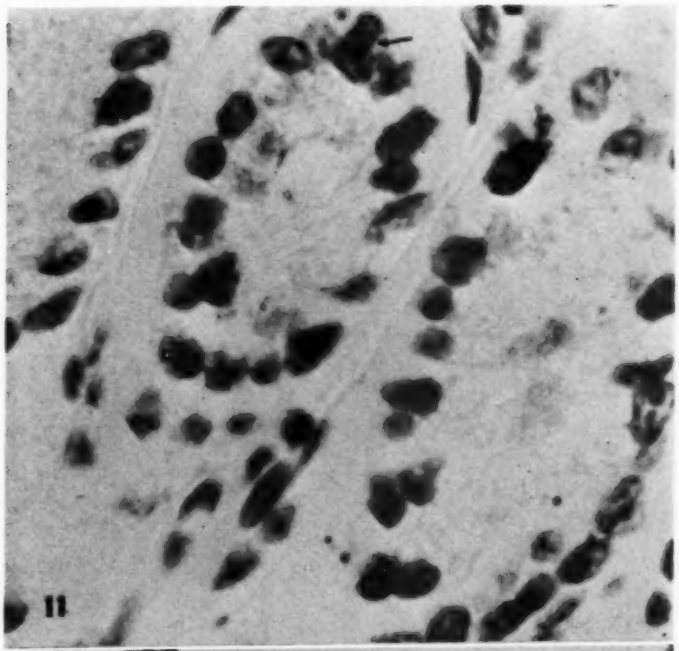


Fig. 9. Small intestine, normal non-irradiated control. Abundant finely granular cytoplasmic and scant nucleolar RNA. Toluidine blue stain. ×1000.
Fig. 10. Small intestine, non-irradiated control. Digested with ribonuclease. Toluidine blue stain. ×1000.



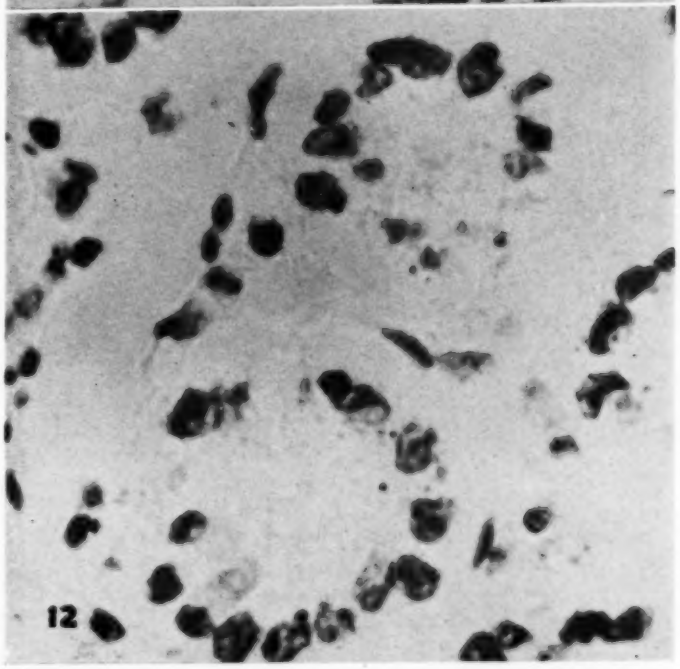
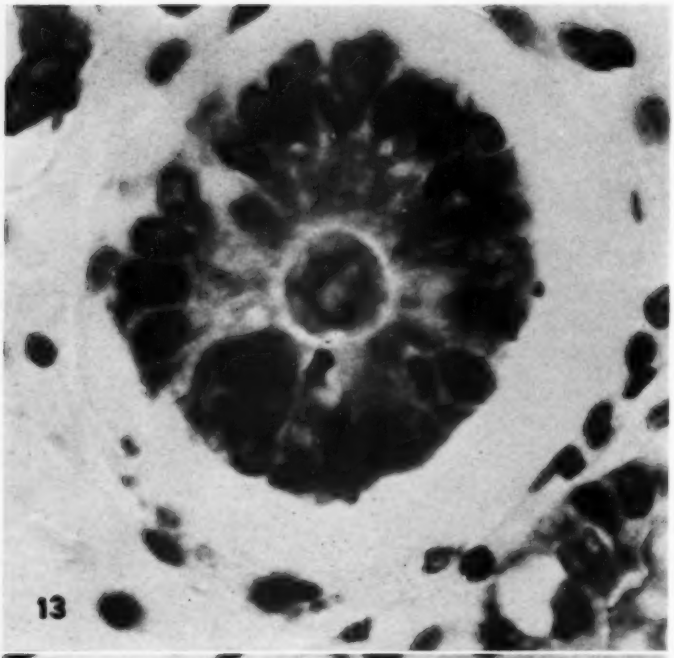


Fig. 11. Small intestine, five hours after irradiation. Depletion of cytoplasmic and nucleolar RNA. Toluidine blue stain. ×1000.

Fig. 12. Small intestine, five hours after irradiation. Digested with ribonuclease. Toluidine blue stain. ×1000.



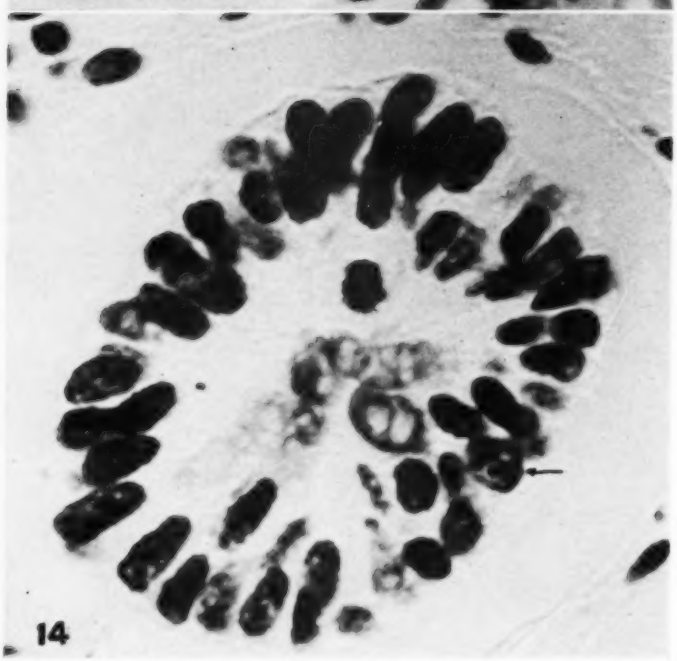


Fig. 13. Small intestine, ten days after irradiation. Note large quantities of cytoplasmic and nucleolar RNA. Toluidine blue stain. ×1000.

Fig. 14. Small intestine, ten days after irradiation. Digested with ribonuclease. Toluidine blue stain. ×1000.

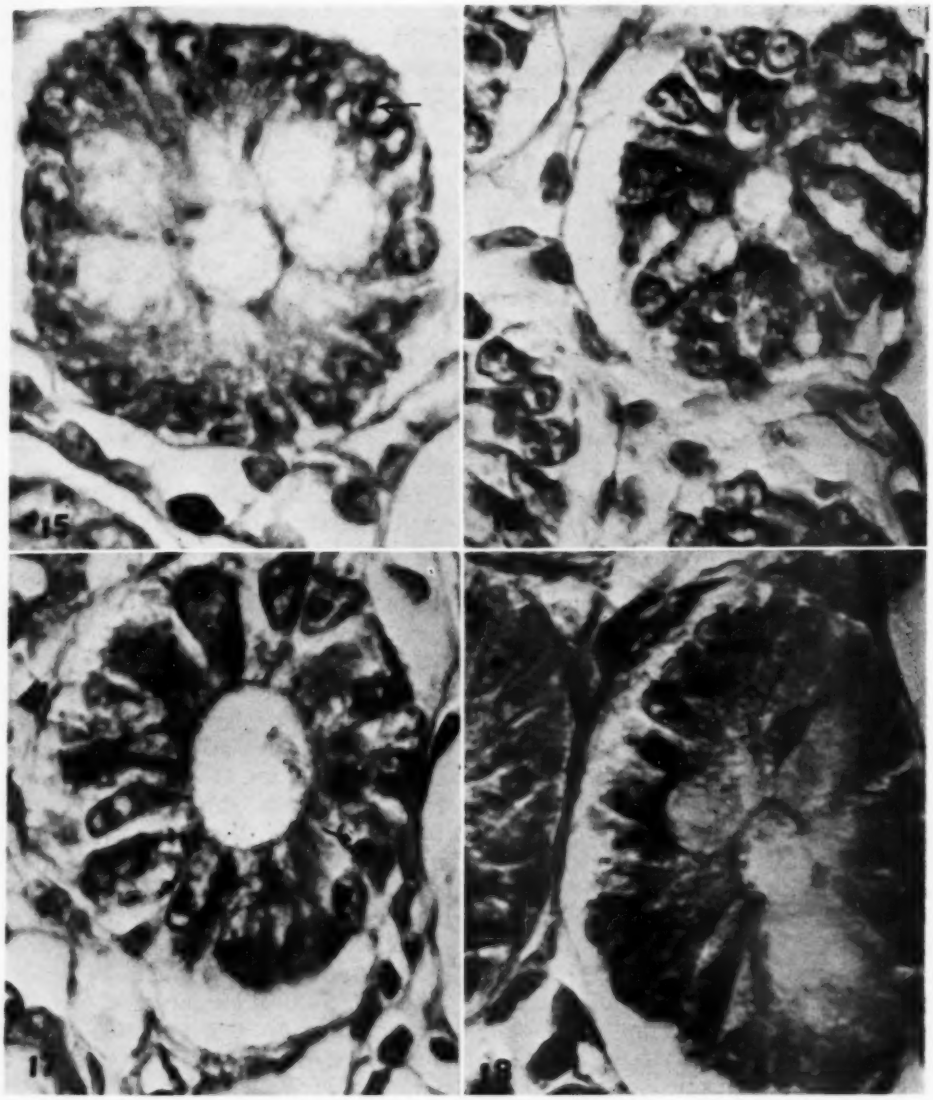


Fig. 15. Small intestine, normal non-irradiated control. Note the dark-stained nucleoli, interpreted as sites of alkaline phosphatase. Method of Gomori counterstained with light green. ×1000.

Fig. 16. Small intestine, five hours after irradiation. Intact nuclei still show nucleolar alkaline phosphatase. Method of Gomori counterstained with light green. ×1000.

Fig. 17. Small intestine, one day after irradiation. The large nucleoli show marked amounts of alkaline phosphatase. Method of Gomori counterstained with light green. ×1000.

Fig. 18. Small intestine, ten days after irradiation. There is a diminution of nucleolar alkaline phosphatase. Method of Gomori counterstained with light green. ×1000.

creased in amount one hour after irradiation but remained unchanged two and five hours later (Fig. 16). Then it gradually increased, reaching a maximum between one and three days. At this time, the nucleoli were approximately two times the normal size and were deeply stained dark brown or black (Fig. 17). At six and ten days, when DNA and RNA estimated concentration was greatest, the nucleolar alkaline phosphatase had begun to decline slightly (Fig. 18). In contrast, nuclear

TABLE IV: CYTOCHEMICAL CHANGES IN THE LARGE INTESTINE FOLLOWING ROENTGEN IRRADIATION*

Time after Irradiation	DNA	RNA		Alkaline Phosphatase		
	Nucleus	Cytoplasm	Nucleolus	Cytoplasm	Nucleus	Nucleolus
Control	4	4	1	1	1	3
1 hr.	3	3	1	1	1	3
2 hr.	2	2	1	1	1	2
5 hr.	2	2	1	1	1	2
10 hr.	2	2	1	1	1	3
15 hr.	3	2	1	1	1	3
1 day	3	2	1	1	1	3
3 days	3	3	2	1	1	3
6 days	4	4	1	1	1	3
10 days	4	4	1	1	1	3
15 days	4	4	1	1	1	3
20 days	4	4	1	1	1	3

* Evaluation of cytochemical changes 0–5. Non-goblet columnar cells in the bases of the crypts. Each figure represents the estimated average value resulting from the observations of 500 to 600 cells.

alkaline phosphatase increased only minimally during the regenerative phase and cytoplasmic alkaline phosphatase remained virtually unchanged.

Large Intestine (Table IV): In the large intestine, the non-irradiated columnar cells in the bases of the crypts were similar to those of the small intestine in morphology and nucleoprotein content. The nucleolar alkaline phosphatase reaction was slightly less intense, however, and was rated 3.

After roentgen irradiation, cellular changes showed less fluctuations than in the small intestine. At one hour, chromatin particles were less well defined and stained less intensely for DNA. Two hours after irradiation, DNA estimated concentration was rated 2. No further reductions occurred. Normal DNA estimated concentration was again present by the sixth day. Changes in cytoplasmic RNA closely paralleled those of DNA. Nucleolar RNA remained relatively unaffected except for a slight increase to 2 on the third day. Nucleolar alkaline phosphatase decreased slightly at the second and fifth hours after irradiation.

DISCUSSION

Although nucleoprotein changes following roentgen irradiation can be demonstrated in any part of the gastrointestinal tract of the rat, there are marked differences in response. The cells of the esophagus and stomach are moderately resistant, while those of the small and large intestine are sensitive.

The columnar cells in the crypts of the small intestine are particularly sensitive, and it is possible to describe several different cytochemical modifications which take place during the destructive and reparative phases.

The first modification is the immediate rapid decrease of stainable DNA, cytoplasmic and nucleolar RNA, and to a lesser extent nucleolar alkaline phosphatase. These changes are probably due to an indirect action of the irradiation where there is formation of intermediate products (1, 25) which compete in the cellular enzyme systems. In this manner, both retardation or arrest of synthesis and degradation or alteration of the nucleoprotein macro-molecules could be effected. Likewise, since it is known that ultraviolet light absorption at 263 mμ is due to the conjugated double bond systems of the purine and pyrimidine rings (8), it is conceivable that in the alteration of these nucleoprotein molecules an increase in effective double bond systems could result. These changes could thus possibly explain the occurrence of the more homogeneous and intense light absorption observed at this time. Agreement, in part, to this idea is found in the work of Taylor, Greenstein, and Hollaender (24) and Sparrow and Rosenfeld (22), who showed that there is a marked decrease in structural viscosity in thymus nucleic acid solution fol-

lowing roentgen irradiation. This change in physical property is interpreted as a decrease in asymmetry, hence degradation, of the nucleic acid molecule. However, Moses, DuBow, and Sparrow (19), employing the methyl green Feulgen reaction on roentgen-irradiated *Trillium erectum*, failed to produce degradation of DNA such as that caused by treatment with hot water or desoxyribonuclease. It has been suggested that the change in nucleic acids following roentgen irradiation is not a true depolymerization but that it represents some other physico-chemical alteration as yet unknown.

The second cytochemical modification is evidenced by a slight increase of DNA in well defined chromatin particles, a marked increase of nucleolar alkaline phosphatase, and a marked but irregular enlargement of the nucleus and nucleolus. The striking feature in this phase is the disproportionate enlargement of the nucleus and nucleolus in relation to the amount of nucleoprotein formed. This alteration of growth pattern is similar to that seen in tumor cells (6) where nutritional conditions are not adequate. It is the type B tumor cell described by Caspersson (6), in which the nucleolar apparatus shows signs of an intense function but little or no nucleic acid formation occurs. Excessive activity of this type in tumor cells usually leads to necrosis. In the post-irradiated cells of the small intestine this activity precedes an excessive production of nucleoprotein.

In the third modification, which occurs by the sixth day after irradiation, there is a marked increase in prominence of stained DNA and RNA and a lessening of the nucleolar alkaline phosphatase. Mitoses, previously scant, are now abundant. The fact that the marked increase of nucleolar alkaline phosphatase precedes the increased production of RNA and DNA would suggest that phosphate from this site is utilized in nucleoprotein (RNA and DNA) synthesis. Numerous workers (23, 2, 4) are in agreement with this hypothesis. Brachet and Jeener (5), for example, found that alkaline phosphatase in the nucleus of adult rat tissue is related to the turnover of phosphorus of DNA. These (3, 13) and other investigators (8) have observed that the enzyme phosphatase is particularly plentiful at the sites of protein synthesis.

In the fourth cytochemical modification, evidence of a governor mechanism is seen. There is an apparent decrease to normal of DNA and RNA production and a stabilization of alkaline phosphatase. The nucleoprotein content and the morphology of the cells are now similar to those of the non-irradiated controls.

Finally, it should be admitted that considerable controversy still exists over the localization of alkaline phosphatase activity (10, 14). Many believe that the nuclear staining is an artifact due to the diffusion and adsorption of calcium phosphate resulting from phosphatase activity in the cytoplasm, and that the degree of adsorption is related to the concentration of the nuclear nucleic acid. But in this experiment, nucleoli were stained most intensely before the greatest apparent concentrations of any of the nucleic acids occurred, and the nuclei themselves never did become heavily stained.

SUMMARY

1. Cytochemical alterations of DNA, RNA, and alkaline phosphatase occur in the epithelium of the gastrointestinal tract of the rat following total-body roentgen irradiation.

2. The cells of the crypts of the small intestine are the most sensitive to roentgen irradiation and show distinctive cytochemical modifications during the destructive and reparative phases.

3. The significance of these modifications is discussed.

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SUMARIO

Alteraciones de las Nucleoproteínas en el Tubo Gastrointestinal Consecutivamente a la Roentgenoirradiación Total del Cuerpo

Presenta este trabajo una justipreciación citoquímica de la concentración relativa, además de un estudio de las interrelaciones de las cantidades, de desoxirribonucleoproteína (DNA), ribonucleoproteína (RNA) y fosfatasa alcalina en las fases destructora y reparadora del epitelio del tubo gastrointestinal de la rata a continuación de la roentgenoirradiación de todo el cuerpo. Los animales recibieron una dosis única de 700 r de irradiación total del cuerpo y fueron sacrificados a plazos que variaron de una hora a veinte días, tomándose cortes del esófago, estómago e intestino grueso y delgado para determinaciones citoquímicas.

Observáronse alteraciones citoquímicas en cortes procedentes de todas partes del tubo gastrointestinal. Sin embargo, las células de las criptas del intestino delgado fueron las más sensibles, revelando modificaciones citoquímicas distintivas durante las fases destructora y reparadora consecutivas a la irradiación. Descríbense esas modificaciones y se discute su importancia.

Roentgenographic Studies of Osteoporosis.

I. Replacement of Common Salt by a Balanced Salt in Diet of Rats[1]

J. GERSHON-COHEN, M.D., and J. F. McCLENDON, PH.D.

SENILE OSTEOPOROSIS is one of the most common ailments in geriatrics. The complications frequently seen by the roentgenologist are fractures of the vertebrae and the neck of the femur. Treatment of these fractures is difficult, and the morbidity and mortality are high. The causes of senile osteoporosis are not well established, but the underlying disturbances mentioned most frequently concern derangements of mineral metabolism and the functioning of the endocrine system (1). The present report concerns roentgenographic studies of osteoporosis in the rat and the effects of the replacement of common salt in the diet by a balanced salt.

METHODS

Although osteoporosis has been produced by diets of purified food substances (5), in these experiments an attempt was made to imitate a diet such as might be common among old people in this country. Owing to economic conditions and deficient teeth, bread is often a prominent constituent of such a diet. In order to imitate the most nutritive qualities of bread, our diets were constituted as follows:

Diet I contained equal parts of freshly ground whole wheat and yellow corn to which 4 per cent sodium chloride was added. To balance this diet, 1 per cent alfalfa meal and 1 per cent linseed meal were added. Each rat was also given 1 gm. of fresh liver each week.

Diet II was identical with Diet I except that the sodium chloride was replaced by a 4 per cent salt mixture made up of 100 parts sodium chloride, 100 parts tricalcium phosphate, and 8 parts Tennessee brown rock phosphate, which contains approximately the following: calcium phosphate, 65 per cent; calcium carbonate, 5 per cent; calcium fluoride, 6 per cent; iron oxide, 4.5 per cent; aluminum, 6.6 per cent; silica, 7 per cent; manganese dioxide, 1.5 per cent, and 0.13 per cent of the rarer trace elements (copper, chromium, magnesium, strontium, barium, lead, zinc, vanadium, titanium, boron, nickel, silver, and iodine).

Diet III was similar to Diet II except for the addition of 5 per cent monosodium glutamate merely for the sake of improving taste, anticipating the use of this salt in a diet for man.

Diet IV was also similar to Diet II, except for the exclusion of the Tennessee brown rock phosphate to determine whether calcium uptake and retention in bones was influenced.

Two groups of experiments were carried out, one on young Wistar weanling rats weighing 40 to 50 gm. and the other on aged rats, 18 months old, 225 to 300 gm.

X-ray examinations and weight records were obtained at the beginning and at the end of the experiments, which lasted two months in the young and six months in the old animals.

RESULTS

The young rats on the balanced high-calcium rock phosphate diet (Diet II) were more than 40 per cent heavier at the end of the experimental period of sixty-two days than those on Diet I (Table I). The x-ray examinations disclosed normal calcification of the bones in these rats, while those receiving Diet I showed clear evidence of osteoporosis (Fig. 1).

Adding 5 per cent monosodium glutamate to the high-calcium rock phosphate diet (Diet III) did not result in findings different from those obtained with Diet II (Table II, Fig. 2).

[1] From the Albert Einstein Medical Center, Northern Division, Philadelphia, Penna. Accepted for publication in August 1952.

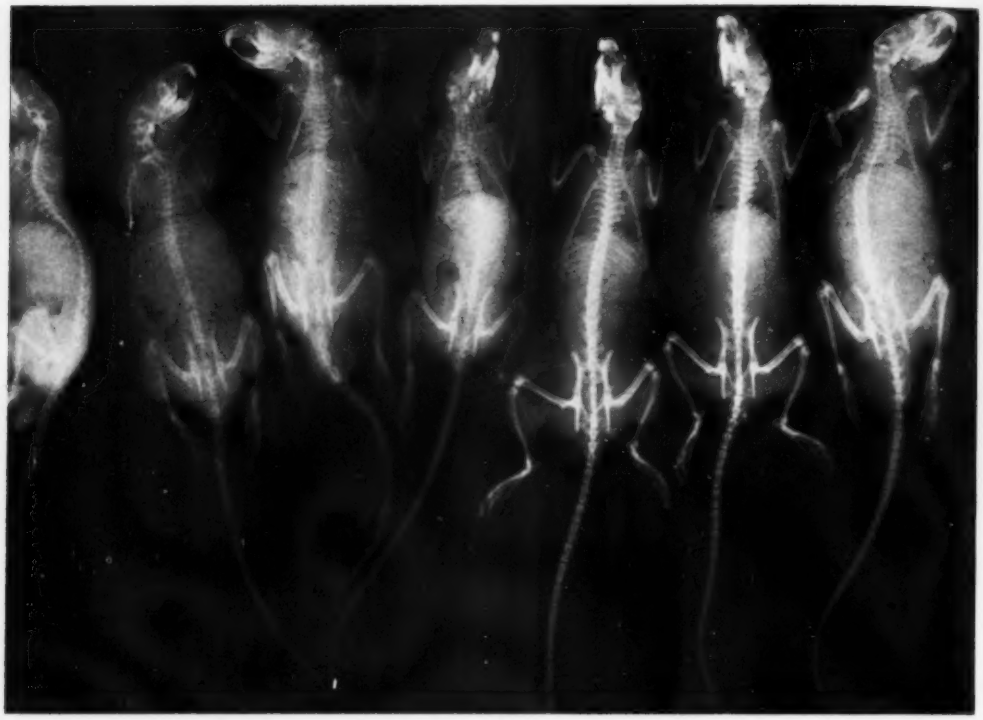

Fig. 1. Osteoporosis and retarded growth in 4 rats on Diet I (to the left), compared with normal calcification and growth in 3 litter mates on Diet II (to the right).

TABLE I: BODY WEIGHT, IN GRAMS, OF LITTER-MATE RATS ON DIETS I AND II

Sex	Diet I				Diet II			
	Male	Male	Female	Female	Male	Female	Male	Female
Weights at weaning	40	39	40	38	40	39	39	37
Weights 62 days later	125	100	117	102	166	143	148	142

Diet IV, in which Tennessee rock phosphate was removed from the salt mixture used in Diet II, reduced slightly the good effects of calcification and growth (Table III, Fig. 3). The fluorine and trace element content of Diet II may explain the greater density of bone in animals thus fed.

In the experiments on the old rats, carried out during the last quarter of life expectancy, the results were not the same as those in the younger animals. No appreciable osteoporosis occurred in those on Diet I, and those receiving the high-calcium phosphate salt mixtures of Diets II, III, and IV revealed no x-ray evidence of improved calcification of the bones, even after six months of observation (Fig. 4).

TABLE II: BODY WEIGHT, IN GRAMS, OF LITTER-MATE RATS ON DIETS I AND III

Sex	Diet I				Diet III			
	Male	Male	Male	Female	Male	Male	Female	Female
Weights at weaning	53	51	57	46	51	53	49	54
Weights 63 days later	110	103	132	102	122	130	104	122

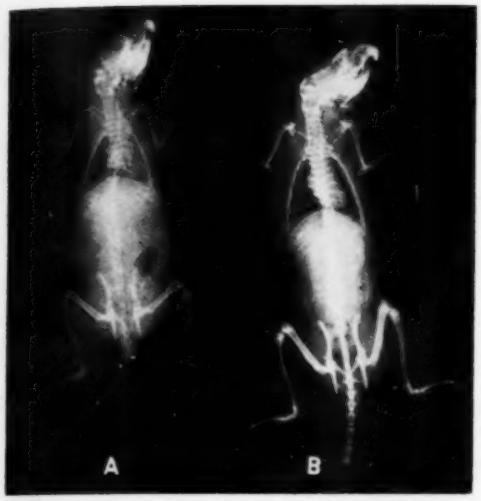

Fig. 2. A. Osteoporosis in rat on Diet I. B. Normal calcification in litter mate on Diet III.

DISCUSSION

Questions are raised by these experiments which are not easily answered. Of especial interest is the difference of the effect of the balanced salt mixtures in the young and old rat. In spite of extensive experience in this field of investigation, Albright could suggest no definite answers to these questions (1). He concludes that in the aged there is a decrease in bone mass as in other tissues, and that this is due to a decrease in bone formation in the presence of a continued normal degree of bone destruction. In other words, new bone matrix does not form so rapidly in the aged as in the young. The problem is one of decreased anabolism rather than increased catabolism. This conception would explain our x-ray observations in the

TABLE III: BODY WEIGHT, IN GRAMS, OF LITTER-MATE RATS ON DIETS I AND IV

Sex	Diet I				Diet IV			
	Male	Male	Female	Female	Male	Male	Female	Female
Weights at weaning	37	35	38	37	37	38	34	35
Weights 52 days later	66	61	61	58	85	98	106	97

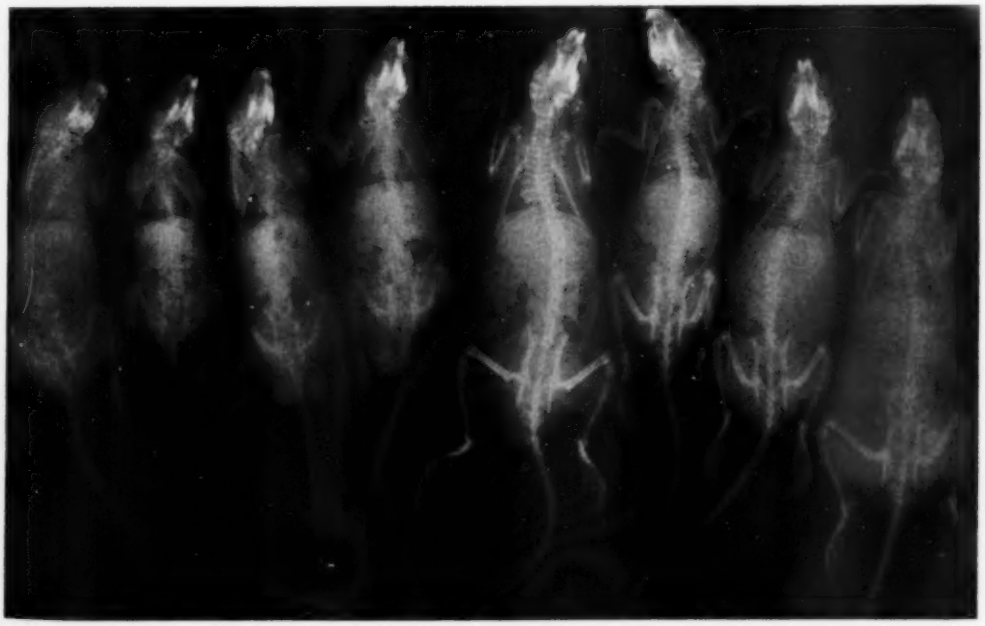

Fig. 3. Osteoporosis and retarded growth in four rats on Diet I (to the left), compared with better calcification and growth in 4 litter mates on Diet IV (to the right).

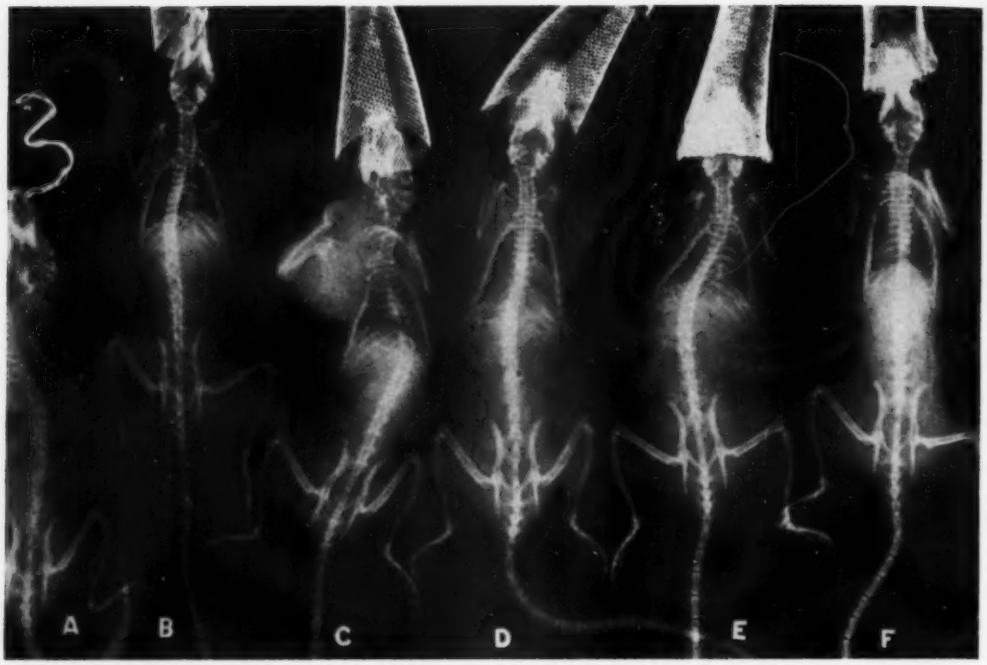

Fig. 4. Calcification of skeleton in senile rats not appreciably influenced by low- or high-calcium, phosphorus-trace-element salt mixtures after six months of observation. A and B. On Diet II. C and D. On Diet I. E and F. On Diet IV. In Rat C a fibrosarcoma developed in the right axillary area.

aged rat, since merely adding or subtracting available calcium and phosphorus salts to old bones which are not in the full flush of anabolism should have little effect on the state of calcification. It does not follow that suboptimal intake of calcium will not be deleterious to health and longevity. Sherman recently called attention again to the maintenance of adult vitality and a 10 per cent increase in longevity in rats on a diet of ground whole wheat containing only one-sixth to one-third dried whole milk (6). Bogdonoff, Nichols, and Shock, working with old men, also confirmed Sherman's recommendations that a daily intake of approximately 800 mg. calcium is necessary to keep old folks in calcium balance (2).

In contrast to the lack of accuracy of short-term balance studies in man, the roentgenogram serves as a good measuring device for chronic forms of osteoporosis. Any remedies devised for senile osteoporosis, therefore, producing effects that can be measured roentgenographically may be accepted as reliable. Moreover, in senile osteoporosis, the x-ray examination has the practical value of revealing changes which precede such clinical manifestations as spontaneous fractures of the spine and femoral neck.

Awaiting improvement is some instrument that could translate the roentgenographic findings in osteoporosis into quantitative terms. Mack, Brown, and Trapp considered the theoretical aspects of quantitative evaluation of bone density (4). More recently technics for automatically correcting densitometer values have been described by Brown and Birtley (3). With the proper applications of these instruments and methods, a better roentgenographic appraisal might be gained of the role of balanced salt mixtures in the metabolism of aged bones.

Calcium is the most plentiful mineral constituent of the body, the skeleton containing more than a kilogram. A negative calcium state could exist a long time before decalcification might become apparent to

the naked eye of the roentgenologist. Whedon and Shorr noted slight osteoporosis in the lower extremities three months after the onset of paralytic poliomyelitis in man, with an average loss of 2 per cent of estimated total-body calcium; but with total calcium losses for seven months of negative balance ranging from 4 to 8.5 per cent, no evidence of osteoporosis could be detected in the spine (7). Moreover, it should be recognized that the origin of senile osteoporosis may stem back to infancy and/or adolescence. Its subtle chronic progress under similar experimental conditions could be detected only by long periods of observation, even with the use of instruments capable of converting x-ray densities into precise quantitative terms.

SUMMARY

Osteoporosis, readily apparent in a roentgenogram, may be produced in weanling rats by a diet deficient chiefly in calcium and phosphorus. This deficiency also prevents normal growth. The replacement of 4 per cent sodium chloride by a 4 per cent balanced salt mixture of 100 parts sodium chloride, 100 parts tricalcium phosphate, and 8 parts Tennessee brown rock phosphate was sufficient to overcome the osteoporosis and the retardation in growth. The presence of small quantities of Tennessee brown rock phosphate in the salt mixture resulted in slightly denser calcification of bones, more noticeable in the roentgenograms of the younger rats. In aged rats, the substitution of common salt by such a balanced salt had little effect on weight or on modifying the state of bone calcification as measured roentgenographically.

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SUMARIO

Estudios Radiográficos de la Osteoporosis. I. El Reemplazo de la Sal Corriente por una Sal Equilibrada en la Alimentación de las Ratas

En las ratillas destetadas, puede producirse osteoporosis, fácilmente observable en una radiografía, con una alimentación deficiente principalmente en calcio y en fósforo. Esa deficiencia también impide el crecimiento normal. El reemplazo de 4 por ciento de cloruro de sodio en el régimen dietético por 4 por ciento de una mezcla salina equilibrada que contenía 100 partes de cloruro de sodio, 100 partes de fosfato tricálcico y 3 partes de fosfato de roca parda de Tennessee bastó para eliminar la osteoporosis y el retardo del desarrollo. La presencia de pequeñas cantidades de fosfato de roca parda de Tennessee en la mezcla salina dió por resultado una calcificación ligeramente más densa del hueso.

En las ratas viejas (de 18 meses), no produjo osteoporosis apreciable la alimentación deficiente y las que recibieron la mezcla salina-fosfática rica en calcio no revelaron signos radiológicos de mayor calcificación ósea, ni aun al cabo de seis meses de observación.

EDITORIAL

Angiocardiography

A considerable literature on the value and limitations of angiocardiography has developed since 1937, when the first successful application of this procedure in children was described by Castellanos, Pereiras, and Garcia (1). Robb and Steinberg (4), in 1938, successfully visualized all the chambers of the heart and the aorta, and under the stimulus of this remarkable achievement various investigators sought to improve the technic of opacification of the cardiovascular system, and to develop specialized equipment for rapid radiography.

Angiocardiography has proved useful in the study of many types of heart disease and in the differential diagnosis of aortic aneurysms from extracardiac masses. Its chief application, however, has been found to be in the accurate diagnosis of congenital malformations of the heart. It has been of special value in differentiating between conditions suitable for operation and those in which surgery would accomplish nothing. Many of these lesions would be impossible of demonstration by any of the usual clinical or radiographic technics.

From time to time there have been published critical analyses of highly specialized procedures of this nature, enabling us to view them in proper perspective. Such an analysis of the clinical value of angiocardiography, recently published by a group of English workers (3), is of great interest to their colleagues in this country. One hundred and eighteen cases of congenital heart disease were studied, and an attempt was made to determine to what extent angiocardiography was helpful to the clinician in this series. The angiocardiographic studies were done at the Royal Infirmary, Sheffield, and in the Postgraduate Medical School of London, almost identical technics being employed in the two institutions. Among the 118 cases, 2 deaths occurred, but these were due to cerebral catastrophes and could not be directly attributed to the angiocardiographic procedure. The authors divide their analysis into ten sections dealing with the various anomalies represented.

The tetralogy of Fallot accounted for the largest number of cases—43—and conclusions based on this group are given in Section I. The results indicate that in this condition anatomical information of great value to the surgeon is furnished by angiocardiography. The position of the aortic arch and its branches and the relationship of the subclavian artery to the pulmonary artery are demonstrated, the presence of both pulmonary arteries is confirmed, and equality or inequality of filling of the lungs is determined. Of less significance is the demonstration of associated congenital anomalies which might be encountered at operation. A serious defect of the procedure was the failure in more than 20 per cent of the group to visualize the type and site of the pulmonary stenosis, but this may be remedied by an improved technic.

As to the diagnosis of the tetralogy of Fallot the authors believe that in the majority of cases this can be made clinically and that angiocardiography serves only to amplify and confirm it. In a smaller group of atypical cases it may be of decisive value in differentiation from other, rarer conditions.

Section II deals with pulmonary hypertension with central cyanosis, under which heading are grouped Eisenmenger's complex, atrial septal defect with right-to-left shunt, and patent ductus arteriosus with

right-to-left shunt. Experience with angiocardiography in this group of 11 patients was somewhat disappointing. It was possible to demonstrate an interatrial shunt or a shunt from the right ventricle to the aorta, but the findings were not such as would differentiate Eisenmenger's complex from a patent ductus with reversed shunt (though no case of this latter anomaly was included in the series), nor was it always possible to exclude the tetralogy of Fallot. Cardiac catheterization would appear to be an essential additional method of study in such cases.

Transposition of the great vessels is discussed in Section III. Here angiocardiography was felt to be of value in confirming the clinical diagnosis. In the 2 cases observed, the systemic outflow tract was shown to stem from the right ventricle and to form the left cardiac border. This angiocardiographic sign, along with fluoroscopic demonstration of overfilled lung fields and enlarged pulsatile main pulmonary arteries, suggests the diagnosis.

In Section IV pulmonary stenosis with normal aortic arch (pure pulmonary stenosis) and pulmonary stenosis with interatrial communication are considered on the basis of 5 and 8 cases, respectively. In 4 of the former cases and 5 of the latter the site of the stenosis was indicated. In both groups angiocardiography proved useful in differentiation from the tetralogy of Fallot, which is of particular importance since in the former cases an anastomotic operation is contraindicated.

Section V is devoted to pulmonary atresia or single outflow tract, of which 7 examples were seen. While this anomaly could not be conclusively demonstrated in the angiocardiogram, absence of opacification of the pulmonary arteries points strongly to the diagnosis. When an abnormally large aorta with displaced aortic root and clearly demonstrated bronchial arteries are also present, the diagnosis of pulmonary atresia becomes almost certain.

Anomalies of the tricuspid valve are considered in Section VI. In tricuspid atresia (3 cases) the contrast medium passed from the right auricle to the left auricle and thence into the left ventricle; the right ventricle did not fill, and there was reflux of the contrast material into the inferior vena cava. Associated anomalies of the outflow tract were present in all the cases. There was reduced pulmonary blood flow in all, and in 2 cases a bronchial arterial supply was evident. In Ebstein's anomaly (2 cases), which consists of maldevelopment of the tricuspid valve resulting in incorporation of a portion of the right ventricle into the right auricle, the salient angiocardiographic finding was an enormous right auricle with poor visualization of the right ventricle and pulmonary arteries, and poor opacification of the lungs. The tricuspid valve was displaced to the left.

Coarctation of the aorta is the seventh type of anomaly considered. This followed tetralogy of Fallot in incidence, accounting for 15 cases of the series. Venous angiocardiography usually gave the necessary information in these cases, demonstrating the site of coarctation in every instance. In 2 cases, however, it was not possible to assess the full length of the involvement. It is believed that aortography furnishes more detailed and accurate information in this group.

Section VIII deals briefly with atrial septal defects. Two uncomplicated cases were seen, while in 18 the defect was associated with other abnormalities. The essential feature is early filling of the left auricle. In uncomplicated cases not apparent clinically, catheterization probably yields more information than angiocardiography.

Patent ductus arteriosus is considered in Section IX. In the 12 cases examined it was felt that the angiocardiogram added nothing to the diagnosis, and it is held to be doubtful that the procedure has any place in the investigation of this anomaly.

Section X concludes the series, covering a miscellaneous group of bizarre cases not otherwise classifiable. Accurate evaluation of angiocardiography in such a group is obviously difficult.

This study, even though covering a relatively small series of cases, is valuable because of the authors' detailed description of their successes and failures and for the excellent angiocardiographic reproductions and pen sketches of the lesions under consideration. It has been reviewed here rather fully because of the importance of the subject in present-day radiology. A helpful note is the authors' insistence that angiocardiography should not be used indiscriminately in all cases of congenital heart disease but should be reserved for those cases where simpler methods have failed.

In a similar analysis, but without statistics of their series of cases, Dotter and Steinberg (2) have reviewed the role of angiocardiography in congenital heart disease. They also feel that this procedure is not invariably indicated but that it has great value in selected cases, especially where surgery is planned. They point out the need of great care in selection of cases, since at least 26 deaths are known to have occurred up to 1950.

Group reports such as these cannot but be of value in the evaluation of angiocardiography. They indicate the shortcomings as well as the value of the procedure in the various congenital lesions and point out certain inherent dangers. They call renewed attention to the fact that angiocardiography is an ancillary study to be used in conjunction with other available methods, including first of all the general clinical data. Most authorities have stressed its particular usefulness to the surgeon, for whom a knowledge of the anatomical conditions existing in any given case is most desirable. The procedure is probably justified in all cases in which an operation is contemplated. Finally, it is incumbent upon the radiologist who would engage in such work to familiarize himself fully with the clinical aspects of congenital heart disease, especially the anatomic variations and the physiologic processes occurring in both normal and abnormal states.

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ANNOUNCEMENTS AND BOOK REVIEWS

AMERICAN COLLEGE OF RADIOLOGY

On Feb. 5, 1953, the Board of Chancellors of the American College of Radiology adopted the following statement in regard to the publicizing of new and experimental methods of radiation therapy in the popular press.

"The Board of Chancellors views with concern the increasing number of articles that are appearing in lay magazines concerning new and as yet experimental methods of radiation therapy. The public interpretation of these articles often creates a false impression as to the benefits of such treatment, and undermines confidence in established and proved procedures, thereby causing false hope and mental anguish in the minds of many people.

"The Board of Chancellors recognizes that while great pressure is often brought on some members concerning the release of new information, it urges that in such cases the members seek the advice and counsel of the Commission on Public Relations of the College.

"It is the opinion of the Board of Chancellors of the American College of Radiology that it is unwise and ill-advised for members of the College to lend themselves to such publicity, which frequently reflects discredit upon the specialty of radiology."

ARIZONA RADIOLOGICAL SOCIETY

At the recent meeting of the Arizona Radiological Society, the following officers were elected for the ensuing year: Bruce M. Crow, M.D., of Mesa, President; Walter T. Hileman, M.D., of Tucson, Vice-President; R. Lee Foster, M.D., 507 Professional Bldg., Phoenix, Secretary-Treasurer.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY

The newly elected officers of the Detroit (Michigan) Roentgen Ray and Radium Society are: President, H. C. Jones, M.D.; Vice-President, James C. Cook, M.D.; Secretary-Treasurer, E. F. Lang, M.D., Harper Hospital, Detroit 1.

GEORGIA RADIOLOGICAL SOCIETY

The annual meeting of the Georgia Radiological Society was held recently in conjunction with the meeting of the State Medical Association. Dr. Robert Moreton of Fort Worth, Texas, was the guest speaker. Newly elected officers are: President, Dr. Stephen W. Brown, of Augusta; Vice-President, Dr. John M. Barner, of Athens; Secretary-Treasurer, Dr. Robert M. Tankesley, 218 Doctors Bldg., Atlanta.

HOUSTON RADIOLOGICAL SOCIETY

The newly elected officers of the Houston (Texas) Radiological Society are as follows: President, Thomas G. Russell, M.D.; Vice-President, F.M. Windrow, M.D.: Treasurer, David M. Earl, M.D.; Secretary, Harry Fishbein, M.D., Medical Arts Bldg., Houston 2.

OHIO STATE RADIOLOGICAL SOCIETY

At the annual meeting of the Ohio State Radiological Society, held at Dayton, May 23 and 24, the following were elected to office: Dr. Austin J. Brogan, of Dayton, President; Dr. Willis S. Peck, of Toledo, Vice-President; Dr. M. M. Thompson, Jr., 316 Michigan St., Toledo, Secretary-Treasurer; Dr. John Hannan, of Cleveland, Member at Large.

PITTSBURGH ROENTGEN SOCIETY

Officers of the Pittsburgh (Pennsylvania) Roentgen Society, elected at the Annual Meeting on June 10, are: President, Edwin J. Euphrat, M.D.; Vice-President, Peter Feltwell, M.D.; Secretary, Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24; Treasurer, Newton Hornick, M.D.; Member of Executive Committee, Paul Meader, M.D.; Councilor to the American College of Radiology, S. G. Henderson, M.D.

SOCIEDAD DE RADIOLOGIA Y FISIOTERAPIA DE CUBA

The newly elected President of the Cuban Society of Radiology and Physiotherapy is Dr. Ricardo Hernández Beguerie. The other officers are Dr. Juan Llambés Estrada, Vice-President; Dr. Rafael Gómez Zaldívar, Secretary; Dr. Raúl Delgado Vargas, Vice-Secretary; Dr. Gonzalo Elizondo Martell, Treasurer; Dr. Miguel A. García Plasencia, Vice-Treasurer.

JOINT MEETING OF OAK RIDGE INSTITUTE OF NUCLEAR STUDIES AND X-RAY INDUSTRY

There will be held on Oct. 4 and 5, at Oak Ridge, Tenn., a joint meeting of the Isotopes Division of the Institute of Nuclear Studies and members of the X-ray Industry interested in teletherapy and radiographic problems with isotopes. The purpose of the meeting is to review informally the current thinking on teletherapy design problems and the protection requirements for large sources, to discuss the possibilities of the standardization of large source encapsulation, and to consider the present status of source manufacture and procurement. All members of the X-ray Industry are invited to participate.

More detailed information may be obtained from the Medical Division, Oak Ridge Institute of Nuclear Studies, Oak Ridge, Tenn.

OAK RIDGE COURSE IN CLINICAL APPLICATIONS OF ISOTOPES

A course on the Clinical Applications of Isotopes, to be held Sept. 14–25, 1953, is being offered by the Special Training Division of the Oak Ridge Institute of Nuclear Studies in cooperation with the Medical Division of the Institute. The course, which is designed primarily for physicians who have had clinical experience with isotopes, will consist of lectures, clinics, and exhibits of equipment. Speakers will include leaders in the specific fields of clinical use of isotopes and staff members of the Oak Ridge National Laboratory, the University of Tennessee-Atomic Energy Commission Agricultural Research Program, and the Institute.

Further information and application blanks may be obtained from the Special Training Division of the Institute, P. O. Box 117, Oak Ridge, Tenn.

CONTINUATION COURSE IN RADIATION THERAPY UNIVERSITY OF MINNESOTA

The University of Minnesota announces a continuation course in Radiation Therapy for Specialists to be held at the Center for Continuation Study on the University campus from Oct. 26 to 31, 1953. Principles and clinical applications of all forms of irradiation therapy will be discussed. The guest faculty will include Dr. Robert McWhirter, Professor, Department of Radiotherapy, Royal Infirmary, Edinburgh; Dr. Raymond Zirkle, Institute of Radiobiology and Biophysics, University of Chicago; Dr. Edith Quimby, Department of Radiology, Columbia University, New York; Dr. Lauren V. Ackerman, Professor of Surgical Pathology and Pathology, Washington University School of Medicine, St. Louis, Missouri. The course will be presented under the direction of Dr. Leo G. Rigler, Professor and Head, Department of Radiology, and Dr. K. W. Stenstrom, Director of Radiation Therapy. Members of the faculty of the University of Minnesota Medical School and the Mayo Foundation will also participate.

Books Received

INVESTIGATIONS ON BACKFLOW IN RETROGRADE PYELOGRAPHY. A ROENTGENOLOGICAL AND CLINICAL STUDY. Acta Radiologica Supplement 99. By ROLF KÖHLER. From the Department of Roentgenology (Director, at time of the investigation: Professor C. Gösta Jansson), The Surgical Hospital, Helsingfors, Finland. A monograph of 92 pages, with 39 figures. Published by Acta Radiologica, Stockholm 2, Sweden, 1953. Price Sw. Kr. 20:—

POST-IRRADIATIVE PROPHYLACTIC EXTRAPERITONEAL LYMPHADENECTOMY IN CARCINOMA OF THE UTERINE CERVIX. Acta Radiologica Supplement 100. By GUNNAR GORTON. From the Gynaecologic Department (Head: Gunnar Gorton), Konung Gustav V:S Jubileumsklinik, Lund. A monograph of 87 pages, with 12 figures and 37 tables, and an Appendix of 231 case histories, each with drawing. Published by Acta Radiologica, Stockholm 2, 1953. Price Sw. Kr. 20:—

THE VALUE OF TOMOGRAPHY IN EXAMINATION OF THE INTRAPULMONARY BRONCHI. Acta Radiologica Supplement 101. By HERMAN LODIN. From the Roentgen Department (Director: Professor F. Knutsson), University Hospital, Upsala, Sweden. A monograph of 110 pages, with 47 figures. Published by Acta Radiologica, Stockholm 2, Sweden, 1953. Price Sw. Kr. 20:—

MICROANGIOGRAPHY. Acta Radiologica Supplement 102. By SVEN BELLMAN. From the Department for Physical Cell Research, Karolinska Institutet, Stockholm 60, and the Department of Surgery, Serafimerlasarettet, Stockholm. A monograph of 104 pages, with 56 figures, 8 in color. Published by Acta Radiologica, Stockholm 2, Sweden, 1953. Price Sw. Kr. 20:—

PRINCIPLES OF VERTEBRAL TOMOGRAPHY. Acta Radiologica Supplement 103. By INGEMAR BOKSTRÖM. From the Roentgen Department (Director: Professor Folke Knutsson), University Hospital, Upsala, Sweden. A monograph of 126 pages, with 67 figures. Published by Acta Radiologica, Stockholm 2, Sweden, 1953. Price Sw. Kr. 20:—

SECTIONAL RADIOGRAPHY OF THE CHEST. By IRVING J. KANE, M.D., Consultant in Chest Diseases, U.S. Naval Hospital, St. Albans, N. Y.; Attending Physician, Chest Diseases, Lincoln Hospital, New York, N. Y.; Associate Physician, Diagnostic Roentgenology, Montefiore Hospital, New York, N. Y. Foreword by EDWARD D. CHURCHILL, M.D. A volume of 154 pages, with 101 figures. Published by Springer Publishing Co., Inc., 1 Madison Ave., New York, N. Y., 1953. Price $7.50.

MAN'S BACK. By THEODORE A. WILLIS, M.D., F.A.C.S., Formerly Head, Department of Orthopedic Surgery, St. Luke's Hospital, Consulting Orthopedic Surgeon, U. S. P.H.S. Hospital, Cleveland, Ohio; Member, The American Orthopedic Association, The American Academy of Orthopedic Surgeons, The Clinical Orthopedic Society,

Société Internationale de Chirurgie Orthopédique et de Traumatologie. A volume of 162 pages, with 210 illustrations. Published by Charles C Thomas, Springfield, Ill., 1953. Price $9.50.

PROGRESS IN BIOPHYSICS AND BIOPHYSICAL CHEMISTRY, Volume 3. Editors: J. A. V. BUTLER, Professor of Physical Chemistry, University of London, Chester Beatty Research Institute, Royal Cancer Hospital, London, and J. T. RANDALL, F. R. S., Wheatstone Professor of Physics in the University of London at King's College. A volume of 386 pages, with 17 figures. Published by Academic Press, Inc., 125 E. 23rd St., New York 10, N. Y., 1953. Price $9.50.

REPORTS TO THE U. S. ATOMIC ENERGY COMMISSION ON NUCLEAR POWER REACTOR TECHNOLOGY. By Commonwealth Edison Company, Public Service Co. of Northern Illinois; Dow Chemical Company and Detroit Edison Company; Monsanto Chemical Company and Union Electric Company; Pacific Gas & Electric Company and Bechtel Corporation. A booklet of 88 pages, with 6 figures and 5 tables. Published by the United States Atomic Energy Commission, May 1953. For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price $.25.

LE GASTRITI (STUDIO RADIOLOGICO). By GIOVANNI GARDELLA AND GIOVANNI SANQUIRICO, Istituto di Radiologia dell'Universita di Genova (Direttore: Prof. A. Vallebona). A monograph of 114 pages, with 52 figures. Published by Licinio Cappelli, Bologna, 1952.

GASTRITI (STUDIO RADIOLOGICO), By LORENZO FELCI, Primario dell'Istituto di Radiologia dell' Ospedale Maggiore di Bergamo. Presented at the 17th National Congress of Medical Radiology, 1952, with the collaboration of Dr. Leopold Celli and Dr. Luigo Locatelli. A monograph of 246 pages, with 259 figures. Published by the Istituto per la Diffusione di Opere Scientifiche, Milan, Italy.

Book Reviews

ROENTGEN, RADIUM AND RADIOISOTOPE THERAPY. By A. J. DELARIO, M.D., Member of the American College of Radiology; American Board of Radiology; Radiological Society of North America; Head of Therapeutic Radiology, St. Joseph Hospital, Paterson, N. J. A volume of 372 pages, with 65 illustrations and 155 tables. Published by Lea & Febiger, Philadelphia, 1953. Price $7.50.

Recent advances in atomic and nuclear energy demand a more complete knowledge of radioactivity and its effect upon man. Dr. Delario devotes approximately a third of this new volume to the nature, production, and biologic effects of ionizing radiation. The remainder deals with the present status of roentgen, radium, and radioactive isotope therapy. The methods of application and recommended tissue dosage for all modalities constitute an integral part of the discussion.

A brief explanation of the mechanism of atomic fission and fusion, as well as a description of the effects and the general protective measures to be employed, are of timely interest.

A good bibliography is included at the end of the volume, and a workable index completes an interesting and informative work.

GASTRIC CANCER. By ALFRED H. IASON, M.D., Attending Surgeon, Adelphi Hospital; Director of Surgery, Brooklyn Hospital for the Aged; Surgeon, Manhattan General Hospital; Instructor in Anatomy, New York Medical College and Flower Hospital. Illustrations by Alfred Feinberg, Instructor of Medical Illustration, Department of Pathology, College of Physicians and Surgeons, Columbia University, New York City. A volume of 316 pages, with 100 illustrations. Published by Grune & Stratton, Inc., 381 Fourth Ave., New York, N. Y., 1953. Price $7.50.

In a well written book, Dr. Alfred Iason deals with all phases of cancer of the stomach, with some discussion of cancer of the esophagus.

The book opens with interesting accounts of the anatomy, histology, incidence, etiology, and pathology of esophageal and gastric neoplasms. The chapters on symptomatology and differential diagnosis, which follow, are exceptionally complete, dealing with all the diagnostic methods of establishing the presence or absence of gastric cancer from the history and physical examination to roentgen studies, gastroscopy and mucosal biopsy.

A full chapter is devoted to presurgical preparation. The apparent interest in psychologic preparation is encouraging. In succeeding chapters details of anesthesia, the different surgical procedures, postoperative treatment, and complications are well covered. Illustrations, especially of the surgical technic, are good.

On the whole, this is a book well worth reading for all those dealing with diseases of the gastrointestinal tract.

SANDOZ ATLAS OF HAEMATOLOGY. Written and compiled by Dr. E. UNDRITZ of the Sandoz Pharmacological Research Laboratories, under the direction of Prof. E. ROTHLIN. Translated into English by Dr. A. M. WOOLMAN. A volume of 92 pages, with 256 illustrations. Published by Sandoz, Ltd., Basle, Switzerland, 1952.

The reader of this Atlas will appreciate at once its superiority over any of the other modern attempts at

covering the field of structural hematology. The 44 excellent color plates actually contain 256 photomicrographic groups of preparations from the blood and blood-forming organs, illustrative of the important and interesting changes affecting such areas of study. Each group in turn consists of from one to six separate photomicrographs. The color reproductions of the actual cells (not drawings!) represent the finest yet to appear in English-language texts, and are actually of a size similar to their appearance under the microscope.

Although largely of Swiss origin, this masterly collection of visual aids in hematocytology has been added to from various collections in clinics throughout the western world. Advertising has been kept to a modest and almost inconspicuous minimum. The price is low and will enable the volume to be placed in the hands of the students of this subject at a time when they are learning the stock-in-trade of hematology, for here is the complete gamut from L. E. cells to Filaria, from Alder's anomaly to phagocytosed sickle cells. For any of the many hematology texts which have appeared in recent years, excellent in written content but all too often devoid of adequate illustrations, this Atlas is to be recommended as a worthy pictorial companion.

ROBERT F. McNATTIN, M.D.

In Memoriam

ROBERT F. McNATTIN, M.D.

Dr. Robert F. McNattin died in Chicago, May 9, 1953, of leukemia. He was born in Rockford, Ill., on Nov. 28, 1902, a son of Edward J. and Mary Gesky McNattin. Most of his childhood was spent in Lincoln, Ill., he was graduated from the Lincoln High School in 1920, and from Lincoln College in 1924. He received his M.D. degree in 1928 from Washington University, St. Louis, and served his internship at the Albert Merritt Billings Memorial Hospital in Chicago.

Dr. McNattin was one of the first Fellows at the Memorial Hospital for the Treatment of Cancer and Allied Diseases in New York City. From then on his whole interest was in the field of cancer, and particularly in its radiation therapy. He joined the staff of the Cook County Hospital, Chicago, in 1935, and there, through his energy and enthusiasm, the Division of Therapeutic Radiology was built up to one of the largest services of its kind. He also acted as consulting radiation therapist for the Sloan Clinic in Bloomington, Ill. Later he became chief of the Cancer Division of the Pennsylvania State Health Department (1946–48), after which he entered private radiological practice in Harrisburg, Penna. He returned to the Chicago area in 1950 and became associated with Dr. Genz Perry of Evanston, Ill. Later he had his own office on the north side of Chicago.

Dr. McNattin was a Fellow of the American College of Radiology and a member of the Radiological Society of North America, the American Medical Association, Illinois Medical Society, Chicago Medical Society, American Cancer Society, and the Chicago Roentgen Society. He contributed several articles to the radiological literature.

"Mac," as he was affectionately known by his associates, will always be remembered as a strong advocate of radiation therapy in the treatment of cancer. He was particularly interested in preoperative irradiation and continually fought for this therapeutic measure, particularly in the treatment of sarcomas and other lesions difficult to handle by any form of therapy.

He will be remembered as a friendly, enthusiastic radiologist by his students and colleagues, and as a courteous and sympathetic physician by his patients. He is survived by his wife, the former Hilda Mose, whom he married in 1937, and by a son, Robert.

IRVIN F. HUMMON, M.D.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Calvin L. Stewart, M.D., 2330 First Ave., San Diego.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, George Jacobson, M.D., 1200 North State St., Los Angeles 33. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL SOCIETY. *Secretary*, Richard C. Ripple, M.D., 1215 28th St., Sacramento. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, William H. Graham, M.D., 634 E. Santa Clara St., San Jose 12. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wm. S. Curtis, M.D., Boulder Medical Center, Boulder. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, Alvin C. Wyman, M.D., 5445 28th St., N.W., Washington. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. Judson Graves, M.D., 2002 Park St., Jacksonville. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, E. Hampton Bryson, M.D., 273 Alhambra Circle, Coral Gables. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton Jr., M.D., University Hospital, Augusta.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Philip S. Arthur, M.D., Suite 42, Young Hotel Bldg., Honolulu. Meets third Friday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 23 East Ohio St., Indianapolis. Annual meeting in May.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and holds a scientific session in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Willis L. Beller, M.D., 700 Kansas Ave., Topeka. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Hugh Allan Smith, M.D., Eastern Maine General Hospital, Bangor. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Leonard Warres, M.D., 2337 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Sidney Rubin, M.D., 410 Professional Bldg., Kansas City, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd., St. Louis 3. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Salomon Silvera, M.D., 921 Bergen Ave., Jersey City. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 8:45 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Joseph J. La Vine, M.D., 259 North Grand Avenue, Baldwin, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Harold W. Jacox, M.D., 622 W. 168th St., New York 32.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, A. Gordon Ide, M.D., 277 Alexander St. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Clifford C. Baker, M.D., Harwood Bldg., Scarsdale. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. M. Thompson, Jr., M.D., 316 Michigan St., Toledo. Meets with State Medical Association.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Chapin Hawley, M.D., 927 Carew Tower, Cincinnati 2. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., 1037 Stuart Bldg., Lincoln, Nebr.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. William A. Klauber, M.D., Self Memorial Hospital, Greenwood. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., Newell Hospital, Chattanooga 2. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, Claude Williams, M.D., Fort Worth. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

HOUSTON RADIOLOGICAL SOCIETY. *Secretary*, Harry Fishbein, M.D., 324 Medical Arts Bldg., Houston 2.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY. *Secretary*, Hugo F. Elmendorf, Jr., M.D., 730 Medical Arts Building, San Antonio 5, Texas. Meets at Brook Army Medical Center, the first Monday of each month.

TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 29–30, 1954, Dallas.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November.

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., 1308 Manteo St., Norfolk 7.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John N. Burkey, M.D., 555 Medical-Dental Bldg., Seattle. Meets fourth Monday, September through May, at College Club, Seattle.

Wisconsin

MILWAUKEE ROENTGEN RAY SOCIETY. *Secretary-Treasurer*, Jerome L. Marks, M.D., 161 W. Wisconsin Ave., Milwaukee 1. Meets monthly on fourth Monday at the University Club.

SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, W. W. Moir, M.D., Sheboygan Memorial Hospital, Sheboygan.

Puerto Rico

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Rafael A. Blanes, M.D., Box 9724 Santurce, Puerto Rico.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, D. L. McRae, M.D. Assoc. Hon. Secretary-Treasurer, Guillaume Gill, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 25, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday of each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Secretary, Dr. Rafael Gómez Zaldívar. Offices in Hospital Mercedes, Havana. Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosio, Marsella 11, Mexico, D.F. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

ABSTRACTS OF CURRENT LITERATURE

ROENTGEN DIAGNOSIS

The Head and Neck

The Chest

The Digestive System

The Musculoskeletal System

Gynecology and Obstetrics

The Genitourinary System

The Blood Vessels

The Soft Tissues

Film Storage

RADIOTHERAPY

RADIOISOTOPES

RADIATION EFFECTS

THE HEAD AND NECK

Acromegaly and Contrasting Conditions. Notes on Roentgenography of the Skull. Sherwood Moore. Am. J. Roentgenol. **68**: 565–569, October 1952.

The author contrasts the skull findings in acromegaly and in metabolic craniopathy (Morgagni syndrome, hyperostosis frontalis interna, etc.). Enlargement of the sella turcica has sometimes been considered an essential part of the skull changes in acromegaly, but normal variations in the size and shape of that structure make determination of abnormality extremely difficult. In the present study, measurements of skull thickness were made at given points, and the average measurements in acromegaly and in allied conditions are presented and contrasted with normal measurements.

In the metabolic craniopathies the skull only is involved, and at the expense of the cranial cavity. In acromegaly the vault itself is not thickened nor is the capacity of the brain case altered except by a slight decrease through extension of the frontal sinus backward and possibly the ethmoids upward. The sella turcica is not necessarily enlarged in acromegaly and not at all in hyperostosis. In either it is frequently small. Enlargement of the sella is due to intrasellar conditions, most frequently to chromophobe adenoma.

Two roentgenograms; 1 drawing; 3 tables.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Clinical and Roentgenologic Diagnosis of Chordoma of the Base of the Skull. L. Psenner. Fortschr. a. d. Geb. d. Röntgenstrahlen **77**: 425-433, October 1952. (In German)

The author briefly reviews the literature and describes the pathological anatomy of chordomas involving the base of the skull. The clinical symptoms and roentgen findings are discussed and 2 cases are presented, one diagnosed by exploration and autopsy and the other presumably diagnosed roentgenologically and responding favorably to roentgen therapy.

The diagnosis of chordoma of the base of the skull is difficult; cerebral angiography and encephalography show no specific changes. Irradiation is recommended, since the tumor is rarely operable but is radiosensitive.

Six roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Diseases of the Ear, Nose, and Throat in the Roentgenogram. Richard Mittermaier. Forstchr. a. d. Geb. d. Röntgenstrahlen, Ergänzungsband 45, 1952, pp. 1–232. (In German)

Mittermaier's contribution is an atlas of radiographs such as are likely to be encountered in the daily practice of an otorhinolaryngologist. The text is found in the description and discussion directly adjacent to each illustration. A study of this book enlightens one far beyond the effort required. To abstract it is impossible. What follows is but a tabulation which has, using the words of Dr. Leo Rigler, "the purpose of stimulating the reader to look up the original if he is not too lazy."

The usual departmental apparatus is adequate for sinus and skull studies. Such devices as the tomogram, stereocassette shifter, Lysholm table, and self-centering cassette holder add convenience but are not essential. The author takes all sinus views upright, at 70 cm., with a grid, and usually in stereo. His routine projections are the occipito-frontal, occipito-nasal, occipito-dental, and vertico-submental. Variations on the standard views, the Rhese oblique view, the Altschul-Uffenorde projection, and the lateral, are obtained when indicated. To interpret these films, in addition to complete knowledge of the normal anatomy, familiarity with certain pitfalls is important: unilateral asymmetry is of doubtful significance; crossed clouding, as of the right antrum and a left ethmoid, probably means inadvertent obliquity in positioning; due to their thicker walls small sinuses may be of high density; excessive pneumatization is a normal variant.

In the 34 illustrations on frontal sinus disease, emphasis is on the typical.

1. Acute frontal sinusitis is usually seen with diffuse clouding.
2. The acute phase may also present fluid levels. These occur in the earlier stages, and later the sinus becomes airless. In children clouding is prone to be quite faint.
3. A frequent combination is hazing of one frontal sinus with a fluid level in the antrum on the same side.
4. Demonstration of acute edema of the membrane requires serial studies.
5. The "danger sinus" is purulent frontal sinusitis threatening break-through into the meninges. When meningitis does follow, bone erosion may be visualized.
6. Allergy typically produces polypoid hyperplasia.
7. Chronic recurrent inflammation yields thickening and eburnation of the walls and partitions.
8. Aplasia of the frontals is almost a normal variant. Hypoplasia of all the sinuses is associated with rhinitis atrophicans, in which one may also detect wide nasal passages, a thin nasal septum, and poor delineation of the conchae.
9. Hematoma of the mucous membrane of the frontal sinus occurs during airplane travel.
10. Mucocele, a sharply bordered tumor of moderate radiolucency, tends to erode bone by pressure. This is not a polyp, but a retention cyst of a mucoid gland, which, when infected, becomes a pyocele.
11. Cholesteatomata (epidermoid inclusions) may be situated in the frontal bone regional to the sinus.
12. Osteomyelitis secondary to sinusitis is becoming rare.

The diagnosis of inflammatory change limited to the ethmoid requires a refined technic and sharp interpretation. One must be alert for acute and chronic ethmoiditis, septal abscess, and nasal polyps originating in the ethmoids. Similarly, isolated disease of the sphenoid is a difficult problem because errors due to the superimposition of parts are frequent. The maxillary sinuses may not only be involved in the same fashion as the frontals and ethmoids but also undergo inflammatory reaction secondary to abscessed upper teeth. Filling of the antra with contrast medium is valuable for the demonstration of polypoid changes in the membrane.

Although the x-ray examination in itself is rarely diagnostic, many tumors and granulomatous processes present more or less characteristic pictures.

1. Radicular cysts and follicular (tooth-containing) cysts are in relation to the alveolar ridge.

2. Osteomata are easily identified on the roentgenogram.

3. Osteitis fibrosa or McCune-Albright syndrome produces a unilaterally enlarged dense sinus or sinuses.

4. Carcinomas of the maxillary sinus and of the ethmoid present such changes as opacification, destruction of the bony walls, detached bone fragments, and soft-tissue swelling.

5. Fibroma of the epipharynx is revealed through the loss of the normal pharyngeal and nasal air shadow combined with pressure atrophy of the bony walls of the nasal cavity.

6. Rhinoliths are usually diagnosed clinically but can be demonstrated radiographically.

7. Tuberculosis is a purely destructive process.

8. Sella turcica changes are incidentally revealed in sinus studies. Hypophyseal tumor, internal hydrocephalus, suprasellar tumor, and bridged sella are detectable.

Of the numerous projections devised to radiograph the temporal bone and the petrous pyramid, most useful are the Schüller, the Sonnenkalb, the Stenvers, and the Meyer. Interpretation of mastoid views involves many pitfalls: excessive pneumatization is a normal variant; unusually large marginal cells are also normal; deficient pneumatization may be due either to childhood infection or to persistence of normal spongiosa; a large, indistinct cell is occasionally seen in a patient denying any infection; a large emissary mastoid vein resembles bone destruction; excessive tortuosity of the sigmoid sinus produces blind sacs in the sigmoid groove; good visualization of the semicircular canals in the adult is less apt to mean good film quality than that they are outlined by diseased bone.

Diffuse veiling of the mastoid cells invariably accompanies acute otitis media, and may be either exudate or membrane thickening. While this clouding disappears with clinical recovery, in those instances in which it persists and in which there is no clinical evidence of mastoiditis, one should withhold opinion and recheck the mastoid in one week. Clouding, decalcification of cell partitions, loss of sharpness of contour, and thickening of the partitions constitute the roentgen signs of mastoiditis. Bone destruction in a poorly pneumatized mastoid process, especially from *Pneumococcus mucosus*, is particularly hazardous because of intracranial extension. The most favorable outlook lies in infection in a well pneumatized mastoid.

Specific types of mastoiditis include occult mastoiditis of infancy, the silent mastoiditis of the diabetic, empyema of the mastoid, Bezold's abscess, metastatic mastoiditis, tuberculosis of the temporal bone, petrositis, labyrinthitis, and post-traumatic mastoiditis.

With bone infection in the petrous pyramid, plus the roentgen evidence of bone destruction, one may have clinically abducens paralysis, trigeminal neuralgia, nystagmus toward the side of the lesion, and facial palsy.

In chronic ear disease the roentgen demonstration of a cholesteatoma, if present, is exceedingly important, since the only adequate treatment is surgical. When a large cholesteatoma breaks through the middle ear to discharge spontaneously and leave a large air-filled cavity, it yields the rare case of spontaneous radical automastoidectomy.

While any tumor may perchance involve the temporal and mastoid region, one should note instances of benign osteoma, eosinophilic granuloma, granuloma telangiectodes, metastatic carcinoma and sarcoma, and hemangioma. Of yet greater importance is the presence of widening of the internal auditory meatus in acoustic nerve tumor, and of loss of the apex of the petrous pyramid in cerebellopontine angle tumor.

Since roentgenography of the pharynx and hypopharynx only supplements endoscopic studies, the usual films with and without barium swallow frequently suffice. Nevertheless, the Rethi-Waldapfel intralaryngeal film and the tomogram should be available in the larger clinics. The value of the tomogram lies in delineation of the extension of a laryngeal carcinoma into the subglottic region.

Aside from routine use in the study of laryngeal and hypopharyngeal carcinoma, the x-ray aids the study of thyroid adenomata, fracture of the thyroid cartilage, interstitial emphysema, thyroglossal cyst, developmental laryngocele, pharyngeal paralysis, Zenker's diverticulum, foreign-body impaction, pharyngeal paralysis, and spondylosis deformans cervicalis.

Four hundred and eighty-three roentgenograms.

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THE CHEST

Chest Radioautography. William M. Loehr. Am. J. Roentgenol. **68**: 355-359, September 1952.

The author defines the term chest "radioautography" as the recording of radioactivity present in the lungs and pulmonary structures by placing the patient's chest in contact with an ordinary exposure holder containing conventional roentgen film.

He presents the case of a 37-year-old white female referred for roentgen therapy for papillary adenocarcinoma of the thyroid. A nodule in the gland had been first observed about ten years previously and had slowly grown without symptoms until 1950, when during pregnancy it increased rapidly in size, causing dysphagia. After delivery, the mass regressed to its prepregnancy status. In 1951, right vocal cord paralysis developed, and a hemithyroidectomy was performed. Since the tumor was densely adherent to the trachea and great vessels, it could be only partially removed. Evaluation of the chest film for metastases was complicated by the presence of extensive fibrocalcareous lesions throughout both lungs and fibrosis in the left apex due to arrested tuberculosis. Review of previous chest films showed no appreciable change since 1939.

Roentgen therapy was given postoperatively, the patient receiving 500 r (in air) to each of three fields over the thyroid in a period of two weeks. Tracer studies with I^{131} revealed 29 per cent uptake within twenty-four hours, almost entirely limited to the region of remaining thyroid tissue. Fifty millicuries of I^{131} were administered. Tracer studies repeated three and a half months later showed localization of a significant amount of radioactivity in the right hemithorax. A therapeutic dose of 79 millicuries was therefore given. Biopsy of a cervical node showed well differentiated papillary adenocarcinoma and the presence of radioactivity in this metastatic tissue was demonstrated by a strip film autograph of a section of the node. The patient was placed supine on a 14 × 17-inch cassette with Par-Speed intensifying screens and Blue Brand Kodak film. The film was processed after an hour exposure and the photographic effect of radioactivity in

the right hilus and right lung was demonstrated. A similar chest radioautograph was made using a cardboard film holder. The distribution of photographic effect of the radioactivity was the same but the degree of blackening was far less.

The author concludes that this method of chest radioautography is a practical and useful procedure in differential diagnosis of pulmonary lesions as well as providing a topographical localization of metastatic lesions within the chest.

Two roentgenograms; 3 radioautographs.

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Recent Developments in Anesthesia of the Tracheobronchial System for Bronchography. W. Keil and H. Vieten. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 409–425, October 1952. (In German)

The use of water-soluble media for bronchography necessitates anesthesia of the bronchial segments as well as of the larynx and trachea because of the irritating effect of hypertonic water-soluble materials on the bronchial mucosa. The authors tested several anesthetics, including Pantocain, Oxycain, Salicain, Bronchocain, and Xylocain for their chemical, pharmacologic, and toxic properties. Pantocain, Salicain, and Bronchocain proved to be equally effective as surface anesthetics. It was also determined that addition of a vasoconstricting substance to these preparations did not increase the anesthetic effect but increased the toxicity. The use of adrenalin with surface anesthetics is therefore contraindicated in bronchography.

The authors recommend 1 per cent Salicain as the anesthetic of choice. It is one-third less toxic than Pantocain. The use of a barbiturate one to two hours prior to the anesthesia is also recommended; the addition of caffeine may counteract the psychic effects of the barbiturate and facilitate the examination.

Eight tables; 2 graphs.

JULIUS HEYDEMANN, M.D.
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Bronchiectasis as Seen in an Ambulant Clinic Service. A Follow-up Study of Forty-nine Cases over a Minimum Period of Nine Years. Anson McKim. Am. Rev. Tuberc. **66:** 457-476, October 1952.

Most reports on bronchiectasis in the past have been based on studies of hospital patients with severe involvement, so that it has been depicted as a progressive debilitating disease usually terminating in death. Although some reports in the recent past have dealt with the more benign form, no long-term follow-up has appeared in the literature. In the study reported here, 49 ambulant clinic patients were observed for nine to twenty years. There were only 5 deaths due to bronchiectasis during the period of observation, with 3 deaths due to other causes. The tendency was toward stability or regression of the disease, with clinical evidence of progression in only 3 of the 41 surviving patients.

It is felt that the textbook descriptions of bronchiectasis are inaccurate in that they deal with a selected group in whom symptoms are of sufficient severity to warrant hospitalization, while the disease is present in many ambulant individuals who have few symptoms despite rather extensive ectasia. The prognosis is therefore quite variable, and it is well to avoid giving a hasty opinion before adequate observation. In the present study a distinct difference was observed in the clinical aspects of the disease at the time of diagnosis, between the cases which proved fatal and those with survival. The patients in the former group were usually chronically ill, poorly nourished, and had extensive saccular bronchiectasis and foul sputum. In the latter group, symptoms were variable and relatively mild. Abnormal bronchographic findings were present in all of the subsequently fatal cases. Of the surviving patients, 31 had roentgen abnormalities on the original examination. In most cases these were still present at the end of the follow-up period. In 9 there was partial clearing, and in 5 the abnormalities had increased.

Because of the wide variation in clinical severity of the disease, with comparable amounts of ectasia, it is believed that a period of observation under medical management should be undertaken before advising surgical removal of the involved lung or portion thereof. Although resection is of undoubted value in many cases, surgery is not indicated whenever resectable bronchiectasis is found.

Thirteen roentgenograms; 8 tables

JOHN H. JUHL, M.D.
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Hidden or Unsuspected Bronchiectasis in the Asthmatic Patient. Richard H. Overholt, James H. Walker, and Francis M. Woods. J.A.M.A. **150:** 438–441, Oct. 4, 1952.

Between Jan. 1, 1948, and Jan. 1, 1952, 76 patients with severe bronchial asthma, classified as medical failures, were studied at the Overholt Thoracic Clinic (Boston). Bronchodilatory and expectorant drugs, desensitization, changes in climate, psychotherapy, antibiotics, ACTH, and Cortisone had all failed. In many of the patients surgical removal of possible foci of infection had also been tried without success.

At the Clinic, complete examination of the bronchopulmonary system was performed in the search for a source of infection. Bronchoscopy was done to reveal a possible foreign body, bronchiectasis, bronchostenosis, or bronchial compression by lymph nodes. Temporary relief was afforded by removal of secretions. Bronchography, however, is considered "the key to accurate appraisal of the asthmatic patient for the presence or absence of bronchiectasis." Careful preparation, including hospitalization, the use of bronchodilatory drugs, and antibiotic medication, was practised but, even so, spasms severe enough to block all the air passages except the main bronchi occasionally made repeated attempts necessary. During fluoroscopy, the dynamic and tonic phenomena mentioned by Di Rienzo (Radiologic Exploration of the Bronchus, Springfield, Ill., Charles C Thomas, 1949. See also Bronchial Dynamism. Radiology **53:** 168, 1949) were sought.

Bronchography was performed on 75 patients. Twenty-seven were found to have bronchiectasis, 13 bilaterally. Exploratory thoracotomy was done in 27 cases, and in 26 diseased tissue was excised; in the other the process was too extensive for extirpation. Two patients had postoperative infections and were unimproved. Twenty benefited greatly. Only 7 still required bronchodilator drugs. Four illustrative cases are reported in detail.

The authors present the thesis that chronic irritation causes muscle spasm and prolonged muscle spasm augments chronic irritation. The cough, hemoptysis,

and purulent sputum of bronchiectasis can produce bronchospasm and, conversely, recurrent bronchospasm can produce bronchial obstruction and infection. Whether bronchiectasis is a primary or secondary source of infection, it furthers the vicious cycle. Its identity may be hidden behind the paroxysms of dyspnea and wheeze of bronchial asthma.

The conclusion is drawn that bronchiectasis, hidden and unsuspected, is often present in asthmatic patients. Once the diagnosis is made, removal, if possible, is imperative and can produce permanent relief.

Six roentgenograms; 2 photographs.

GEORGE A. SHIPMAN, M.D.
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Lobar Emphysema in Infants and Children. Harry W. Fischer, Willis J. Potts, and Paul H. Holinger. J. Pediat. **41**: 403–410, October 1952.

Six cases of dyspnea and cyanosis in infants as a result of lobar emphysema are reported. The clinical course of these 6 patients was similar. An infant or young child, previously well, experienced dyspnea or cyanosis, or both, unrelated to a febrile pulmonary inflammatory process. Symptoms progressed and responded poorly to conservative therapy. The physical examination revealed hyperresonance and diminished breath sounds over one hemithorax or a lobar area, with displacement of the heart and mediastinum in the opposite direction. Roentgenograms showed a large area of localized radiolucency with shift of the heart and mediastinum away from the radiolucent side. The diaphragm on that side was likely to be depressed. The area of radiolucency was usually in the distribution of a single lobe, but frequently the lobe was so overdistended that it was difficult to recognize it as such. The radiolucent area could be diagnosed as emphysema rather than pneumothorax or single or multiple cysts, because lung markings were present throughout the entire area.

Deficiency of the cartilaginous rings of the bronchus was demonstrated to be the cause of lobar emphysema in 2 of the cases. In 2 others, a persistent ductus arteriosus was thought to be a factor. In each of these cases, the ductus overlay the main left bronchus, and was attached low on the left pulmonary artery. The occurrence of a left upper lobe emphysema as a result of compression of the left main stem bronchus is probably due to the smaller expiratory forces acting on the upper lobes. Thus, the increased expiratory force of the lower lobe was able to drive the air out of the lung during expiration. In 3 cases, no bronchial lesions could be demonstrated, nor was any intrathoracic lesion noted at time of operation.

For lobar emphysema caused by a bronchial abnormality or an intrathoracic vascular lesion, lobectomy has been the only effective treatment.

Five roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Acute Diffuse Interstitial Fibrosis of the Lungs. William P. Callahan, Jr., John C. Sutherland, John K. Fulton, and John R. Kline. Arch. Int. Med. **90**: 468–482, October 1952.

Acute diffuse interstitial fibrosis of the lungs is a disease of unknown causation characterized by sudden onset of cough, hemoptysis, dyspnea, cyanosis, and fever. Death from cardiac failure or pulmonary asphyxia has occurred in the reported cases after an illness of a few weeks. The fundamental pathologic change is a diffuse proliferation of fibrous connective tissue, which involves the interstitial tissue of the lungs, with subsequent alterations in the pulmonary circulation. Associated changes consist of metaplasia of the epithelium of the bronchi and of the pulmonary alveolar lining, the formation of intra-alveolar hyaline membranes, and thickening of the pulmonary arterioles.

A case of acute interstitial fibrosis of the lungs in which there was also an undifferentiated carcinoma of the right lower left bronchus is presented. The patient complained of muscular weakness, loss of weight, shortness of breath, cough, and hemoptysis. Dyspnea and cyanosis progressed until death. Chest roentgenograms demonstrated a peribronchial thickening at the lung bases, especially the left. The pleura overlying the dome of the left diaphragm was thickened, and there was a small amount of fluid in the left costophrenic angle. Subsequent roentgenograms revealed a progression of the peribronchial densities, which were more advanced in the right lung. These clinical and roentgenological observations were analogous to those previously described in cases of acute interstitial fibrosis.

Microscopic examination of the autopsy specimen revealed a large amount of fibrous connective tissue throughout the parenchyma and deposition of fibrin within the alveoli. A conspicuous finding was the complete absence of fluid in the pleural cavities and the lack of any exudate on the surfaces of the visceral pleura. A proliferation of young capillaries in the interalveolar regions was associated with interstitial edema, and the resulting separation of cellular constituents produced a widening of the alveolar septa.

The etiology of this disease is not known, but the possibility of a viral agent or of chronic pulmonary lymphedema as a causative factor is considered.

Four roentgenograms; 5 photomicrographs; 1 photograph; 1 table summarizing the reported cases.

HOWARD L. STEINBACH, M.D.
University of California

Primary Atypical Pneumonia in Childhood. G. R. Russell, Walter E. Brown, and W. A. Betts. South. M. J. **45**: 906–914, October 1952.

The authors report a series of cases of primary atypical pneumonia from private pediatric practice and the pediatric department of a large hospital seen over a one-year period. The ratios of primary atypical to bacterial pneumonia were found to be 20:1 and 6:1, respectively, for the two groups as compared to a 10:1 ratio in the Armed Forces during World War II.

This disease is mildly contagious. It is prevalent throughout the year, with peak incidences in the summer and late fall. The highest incidence is at two years, with a gradual decrease in older children. Fifty-six per cent of cases were in males.

Cough was invariably present, usually non-productive, rarely with hemoptysis. Dyspnea and cyanosis appeared more frequently than in adults. In general physical findings were minimal.

The principal x-ray change was a fairly well localized area of increased density, which might occur in any lung segment but was most often seen at the bases. These areas differed from those of lobar pneumonia in that they were seldom of great size and were less

opaque. The margins were ill-defined, blending into the lung substance. The process was usually unilateral. A few cases showed hilar localization. Serial films were necessary to distinguish disease in the upper lobes from acid-fast infections.

Eighty-five per cent of white counts were between 3,000 and 12,000, with occasional counts up to 21,000. There was usually a relative increase in neutrophils.

Response to Aureomycin was striking. In general, Penicillin and Sulfadiazine were without effect.

Four roentgenograms; 11 charts; 4 tables.

MASON WHITMORE, M.D.
Jefferson Medical College

Friedländer's Pneumonia. A Report on Six Cases. J. M. Barber and A. P. Grant. Brit. M. J. 2: 752–755, Oct. 4, 1952.

Six cases of Friedländer's pneumonia are reported, representing 2.5 per cent of all the cases of pneumonia admitted to the medical department of a general hospital. The characteristic findings consisted of an acute onset with rapid progression to a grave clinical status. The temperature in this series was not as high as in pneumococcal pneumonia. The sputum has been previously described as a brick-red, homogeneous emulsion of blood and mucus, and this was true of 2 of the authors' patients.

The roentgen picture in the acute phase of the disease may be similar to that of ordinary pneumonic consolidation. The pneumonia tends to involve the upper lobes, and the shadow cast has been described as homogeneous and resembling fluid. Within a day or two, the destruction of the pulmonary stroma and abscess formation can usually be seen as less opaque areas within the consolidation.

The most important complication is the formation of multiple thin-walled cavities. This occurred in 2 of the patients of this series, but they were nevertheless able to return to strenuous activity. Usually these multiple cavities do not produce symptoms, and they may remain stationary for years.

Two of the 6 patients died, one of the deaths having occurred before treatment could be instituted. Characteristically, this type of pneumonia does not respond to Penicillin, but Streptomycin is effective if given early. Chloramphenicol and Aureomycin have also produced good results in some small series mentioned by the authors.

Two roentgenograms.

DEAN W. GEHEBER, M.D.
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Pulmonary Tuberculosis in the Rhondda Fach. An Interim Report of a Survey of a Mining Community. A. L. Cochrane, J. Glyn Cox, and T. Francis Jarman. Brit. M. J. 2: 843–853, Oct. 18, 1952.

The present report represents the first stage in a long-term experiment to test the theory that progressive massive pulmonary fibrosis is a tuberculous lesion modified by the presence of coal dust. It is hoped to measure the incidence of progressive massive fibrosis (P.M.F.) in miners with simple pneumoconiosis when the environment has been made as free from tuberculous infection as possible. The task of reducing tuberculous infection in a large area is the subject of this particular study. The objectives were (1) to make as complete an x-ray survey of the population as possible; (2) to detect all infectious cases of tuberculosis; (3) to reduce the infectivity of all subjects with positive sputum; (4) to obtain an accurate estimate of the prevalence of tuberculous infection in the area, by tuberculin-testing of the school children.

The area chosen for the experiment was the Rhondda Fach (the Little Rhondda), a narrow winding valley in Wales of about 19,000 adult population, containing eight towns grouped around four collieries. It is relatively secluded, and pneumoconiosis is prevalent among its numerous miners and ex-miners. The survey took place in the winter of 1950—51. In order to treat the patients in whom disease was discovered, 54 beds were set aside in a local hospital. Of the male population 91.7 per cent and of the female population 86 per cent were examined radiologically.

Cases of tuberculosis were classified as infectious, active, and quiescent. In miners with pneumoconiosis, massive fibrosis and active tuberculosis were considered indistinguishable from a roentgen standpoint and were classified together.

Complete tables give the figures for prevalence of tuberculosis by age and sex. These are further broken down in the male group for miners and ex-miners, non-miners, and males exposed to other dusts. In the females the overall incidence of infectious tuberculosis was 7.1 per 1,000 and in males 6.2 per 1,000. In the females the greatest incidence for infectious and active tuberculosis was in the age group twenty to twenty-four; 22.9 per 1,000 for the former and 35.6 per 1,000 for the latter. Analysis of the group with progressive massive fibrosis showed 1.1 per cent positive sputums out of a total of 736 patients with this condition. Tuberculin testing of the school children revealed a prevalence of tuberculosis not unlike that in other urban areas of England and Wales tested in the same manner.

The survey revealed that about 30 per cent of the miners and ex-miners had some roentgen signs of pneumoconiosis and that about 15 per cent had progressive massive fibrosis.

All but 2 of the cases of infectious tuberculosis were given hospital treatment. As a result of the program the number of infectious cases in the valley has been reduced by approximately 60 per cent. These cases are being closely supervised by a health officer.

Further survey contemplated for 1953 has as its primary objective the determination of change in the rate of appearance of new cases of tuberculosis and of massive fibrosis, under the improved local situation. An appendix is included which summarizes the technic of the survey and gives in detail the errors in determining population, the radiological technic, procedure, personnel, and method of work. A critique of the statistical methods used is also given.

An editorial comment in the same issue of the journal (p. 870) states that this projected survey will certainly add to the knowledge of the epidemiology of tuberculosis since with the advent of the Rhondda survey there was a probable rise in notification rate without any increase in the real prevalence of the disease in the community.

Fifteen graphs; 11 tables.

JOHN F. RIESSER, M.D.
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Value of Mass Chest Roentgen-Ray Survey Methods in Control of Lung Cancer. Lewis W. Guiss. Cancer 5: 1035–1040, September 1952.

The author stresses the importance and necessity of treating lung cancer while it is still in the presympto-

matic phase if cure is to be obtained. He feels that cancer of the lung is the one internal cancer of the so-called inaccessible sites that can be almost routinely discovered in its asymptomatic and still curable phase by the simple expedient of routine roentgenographic examination of the chest. Overholt is cited as having shown that when prompt treatment has followed discovery by x-ray survey of cancer in the silent phase, all lesions were resectable, 75 per cent showed no evidence of lymphatic spread, and all patients in the group were still living. In contrast if the patient or doctor waited until there were symptoms, approximately 90 per cent of the lesions had extended beyond the lung and the possibility of cure was less than 10 per cent (see Overholt: Am. Rev. Tuberc. **62**: 491, 1950. Abst in Radiology **57**: 595, 1951. Also, Overholt and Atwell: Cancer of the Lung. New York, American Cancer Society, 1950).

This report deals with the results of a 70-mm. x-ray survey of the chests of 1,867,201 persons made in Los Angeles County in the ten-month period ending Jan. 30, 1951. All persons whose 70-mm. film showed abnormal shadows suggesting significant chest disease were asked to return for a confirmatory film. In the case of the neoplasm suspects this was a conventional 14 × 17-inch x-ray film. A total of 64,745 persons were asked to return for confirmatory films, of whom 54, 648 complied. The findings on these confirmatory roentgenograms were as follows:

Essentially negative	14,344
Evidence of old healed disease	9,216
Tuberculosis	18,785
"Other chest disease" (including neoplasm suspects)	5,646
Cardiovascular diseases	6,657

Each confirmatory roentgenogram was reviewed by a diagnostic team consisting originally of a radiologist, internist, and tuberculosis specialist. At a later period a thoracic surgeon was added to the reviewing team. Of the 5,646 roentgenograms designated as showing other chest disease, 3,500 were placed in a specially organized chest tumor registry. This represents an incidence rate for tumor suspects of 1.9 per thousand patients examined in the survey. The status of the 3,500 patients suspected of having chest tumors was as follows at the time of this report:

Chest neoplasm ruled out	1,537
Chest neoplasm confirmed	240
Lesion metastatic	89
Goiter	417
Tumor, clinically benign, not treated	206
Treatment refused	74
Lost	108
Diagnosis pending	829

The distribution of the 240 confirmed neoplasms is shown in the following tabulation:

Malignant (Total 177)		
Carcinoma		
Bronchogenic carcinoma, unspecified	114	
Epidermoid carcinoma	21	
Adenocarcinoma	8	
Malignant pheochromocytoma	1	
	—	144
Sarcoma		
Unspecified	3	
Lymphosarcoma	7	
Lymphoma	7	
Hodgkin's disease	10	
Lipomelanic reticulosis	1	
	—	28
Unspecified pathology		5
Benign (Total 63)		
Neurofibroma	17	
Adenoma	3	
Mediastinal tumor	5	
Benign tumors, lung	15	
Benign tumors, rib	11	
Lipoma	4	
Hamartoma	3	
Leiomyoma of esophagus	1	
Thymoma	2	
Mesenchymoma	1	
Myeloma	1	
	—	63

Of the 144 confirmed pulmonary carcinomas, 82 were submitted to surgery, giving an overall operability rate of 57 per cent. Sixty-eight resections were done (resection rate 47 per cent). Of the 144 patients with proved bronchogenic carcinoma, only 5 (3.5 per cent) were less than forty years of age.

The unit cost of the survey was $0.754 per person, $396 per chest tumor suspect, and $9,625 for each proved bronchogenic carcinoma. The author emphasizes the difference between such a case-finding program for an infectious disease, such as tuberculosis, and for cancer. In the former instance a single survey can be expected to have a definite and sustained effect by removing potential sources of infection; in the latter case the survey must be repeated at periodic intervals. It is suggested that from a practical point of view periodic chest x-ray surveys planned primarily as a lung cancer control measure might be restricted to a chest roentgenogram twice a year in men more than forty years of age.

Seven tables.

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Adenocarcinoma Developing in a Peripheral Bronchial Adenoma. Report of a Case. William Umiker and Clifford F. Storey. J. Thoracic Surg. **24**: 420–426, October 1952.

The authors state that, although there is no longer doubt concerning the malignant potentialities of so-called bronchial adenoma, no well authenticated instance showing clear-cut histologic proof of transition to adenocarcinoma has been recorded. The purpose of their report is to describe a case with convincing evidence of the development of adenocarcinoma in a peripheral bronchial adenoma. This adds further weight to the view that bronchial adenomas should be managed by conservative pulmonary resection and that endoscopic removal is not an acceptable method of treatment.

The patient was a 32-year-old white man in whom an oval density in the right upper lung field was found on a routine chest film in 1945. Laboratory and physical examinations were negative, and the patient was asymptomatic and afebrile. At that time the diagnosis was arrested pulmonary tuberculosis. Subsequent chest roentgenograms showed no significant change until

July 1951, when marked enlargement of the mass was discovered. The lesion was well circumscribed, dense, but not homogeneous, and several areas suggested calcium deposition as well as cavitation. The patient was still completely asymptomatic, but he had slightly diminished breath sounds and scattered dry râles in the right upper lung area, laterally and posteriorly. The bronchoscopic examination was negative and bronchial secretions were negative for acid-fast bacilli and tumor cells.

In January 1952 a right thoracotomy was performed. Frozen sections of the mass were reported as "well differentiated adenocarcinoma," and a right upper lobectomy was performed. The pathologic examination showed a soft, necrotic spherical mass with the borders fairly sharply demarcated but not encapsulated. On microscopic examination the tumor pattern varied considerably in different sections and within portions of the same section. In many sections there was a strong resemblance to carcinoid tumor. In other portions malignant appearing glandular structures separated by varying amounts of dense fibrous connective tissue were encountered, typical of adenocarcinoma of the bronchi. Several hilar lymph nodes removed during surgery were negative for tumor.

The authors state that, since the tumor apparently was quiescent for a period of six years and then showed sudden enlargement and central cavitation, it seems highly probable that the adenocarcinoma was not present initially but developed in the adenoma about the time of the rapid increase in size.

Two roentgenograms; 7 photomicrographs.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

Obstructive Pneumonitis Secondary to Bronchial Adenoma. Robert P. McBurney, O. Theron Clagett, and John R. McDonald. J. Thoracic Surg. **24**: 411–419, October 1952.

Bronchial adenoma is usually a slow-growing tumor, metastasizing in about 5 to 10 per cent of cases and doing its most serious harm by bronchial occlusion and its effects. On the basis of 102 cases encountered at the Mayo Clinic through December 1950, the authors undertake to discuss the suppurative processes associated with this tumor in respect to incidence, form, and effects on resectability, morbidity, and mortality. For analysis the cases are divided into two groups, 39 in which resection of the tumor was not undertaken and 63 resected cases.

Of the non-resected group, 21, or 54 per cent, showed roentgenographic or bronchoscopic evidence of moderate or severe pulmonary suppuration, in the form of severe saccular bronchiectasis or pulmonary abscess or a copious flow of pus from regions distal to the tumor. In a follow-up of the 39 patients, 10 were found to have died. In 7 of these pulmonary suppuration was a direct cause of death or a major contributing factor.

Sixty-three cases were treated by resection and the resected specimen was examined in every instance. Moderate or severe pulmonary suppuration occurred in 58 per cent. Pneumonectomy was performed in 32 cases and lobectomy or multiple lobectomy in 31. In 30 cases no special difficulty in resection was encountered due to the suppurative process; moderate difficulty resulted in 14, and great difficulty in 19 cases. In 10 patients a postoperative empyema developed. There were 5 postoperative deaths in the series, at least 2 of which seem to have been related to suppuration and obstruction.

It was observed that in general the severity of suppuration was proportionate to the degree of obstruction. In cases in which the tumor was located peripherally, obstruction was slight and pneumonitis was minimal. It was also found that, in general, the longer the duration of symptoms the more frequent and more severe was the suppuration.

In summarizing their observations, the authors state that approximately 55 to 60 per cent of patients with bronchial adenoma will have significant degrees of obstructive pneumonitis; that such suppurative processes add to the difficulty of surgical resection, and that, in their series at least, deaths from suppuration greatly outnumber deaths from metastases (7 to 2).

Two photographs; 5 tables.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

The Management of Patients with Abnormal Chest X-Rays. E. E. Glenn. J. Missouri M. A. **49**: 825–832, October 1952.

The discovery of a chest lesion in the course of a mass x-ray survey, or incidentally in the course of other examinations, indicates further diagnostic study. This may include a careful history and physical examination, complete x-ray examination of the chest, laboratory tests, especially bacteriologic and serologic studies, bronchoscopy, and bronchography. Lymph-node biopsy and even exploratory thoracotomy may be called for. The author presents 11 cases indicative of the variety of conditions discovered in the course of routine surveys.

Thirteen roentgenograms.

Berylliosis. Summary and Survey of All Clinical Types in Ten-Year Period. Joseph M. DeNardi, H. S. Van Ordstrand, and George H. Curtis. Cleveland Clin. Quart. **19**: 171–193, October 1952.

Berylliosis occurs chiefly in persons engaged in the extraction and processing of beryllium and in fluorescent lamp manufacture. No known cases have been reported in association with the mining or handling of beryl ore. This report, which actually covers twelve years (1940–52), comes from an area in Ohio in which the extraction and processing industry is largely concentrated. In the period under consideration, 461 cases of beryllium poisoning were seen.

Prevention of berylliosis is important, since there is no specific therapy, though recently ACTH and Cortisone have given encouraging results. Control of atmospheric concentration of beryllium dusts, rigid preemployment screening, and weekly examination of workers (including pulmonary roentgenograms), as practised in the extraction plants included in the authors' survey have greatly reduced the incidence and eliminated mortality in recent years.

Experimental and clinical observations suggest that the beryllium ion is the sensitizing allergen in both the dermal and pulmonary syndromes. Urinary excretion of beryllium and the beryllium content of necropsied tissues are valuable laboratory findings in establishing a diagnosis. The presence of beryllium in urine indicates past or recent exposure to beryllium, but concentration has no apparent relationship to existence or severity of the specific disease process.

Two cases are presented in detail, including chest roentgenograms. The first patient had an acute chemical pneumonitis; the second had two attacks of acute tracheobronchitis. Both recovered, left the beryllium industry, and died five years later of unrelated causes. At autopsy, both showed significant amounts of beryllium in various tissues, especially the lungs.

Acute dermal manifestations were observed in 209 cases. Of these, 63 were thought to be a result of beryllium salts acting as primary irritants. In 146, the dermatitis, of eczematous type, was a result of acquired sensitization. *Beryllium ulcers* may occur when crystals of the soluble salts become implanted under the skin.

Acute tracheobronchitis invariably was caused by inhalation of vapors, dust, or mists of BeF_2 or $BeSO_4$. In these cases pulmonary roentgenograms may show increase in the bronchovascular markings. One hundred and twenty-nine cases were seen and in all complete recovery ensued, clinically and roentgenographically. Thirty-four-patients of the group were available for follow-up, and data on 20 are tabulated. All of these, after recovery, continued to show beryllium in the urine.

Acute chemical pneumonitis due to beryllium may be insidious or fulminating, the onset occurring from seventy-two hours to several weeks following exposure. Chest films become positive from one to three weeks after the onset of symptoms. The findings, in chronologic sequence, are: diffuse bilateral haziness, usually of the lower lung fields, irregular soft parenchymal infiltration, and finally discrete or conglomerate nodules. Ninety-three cases were observed, with 10 deaths. Forty cases were followed and the results are tabulated for 20. All continued to show beryllium in the urine. Autopsy in 7 cases showed a considerably higher tissue content of beryllium than did the necropsy analysis in chronic cases.

Chronic pulmonary granulomatosis (berylliosis) is characterized by pulmonary insufficiency. Onset is from a few months to several years following initial exposure. Serial cardiopulmonary roentgenograms reveal a transition from a generalized granulation of the parenchyma in the early stages to the late phases of nodulation, emphysematous changes, and cor pulmonale. Only 1 of 31 patients in this group had a medically established diagnosis of previous acute tracheobronchitis, while 4 gave suggestive histories. In none of the cases of acute pneumonitis which have been followed has the chronic or delayed form developed. In all 5 cases in this group in which autopsy was done beryllium was found in the tissues.

Four roentgenograms; 7 tables.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Chest X-Ray Findings and Some Clinical Aspects in Pulmonary Paragonimiasis. A Study of 100 Cases Observed in Taiwan. Sze-Piao Yang, C. S. Cheng, and C. M. Chen. J. Formosan M. A. **51**: 451–458, October 1952.

Roentgen findings in pulmonary paragonimiasis are variable. Some of the 100 cases studied showed well defined pulmonary nodules; others ill-defined transient infiltrations or ring-like shadows. Pleural effusion and spontaneous pneumothorax were observed, the former quite commonly. Peripheral and hilar calcifications were also noted.

Paragonimiasis is an infestation by the oriental lung fluke, *Paragonimus westermani*, due usually to consumption of parasitized raw crabs or crayfish in endemic areas (in this instance, Formosa). The metacercariae pass from the intestinal wall through the abdominal cavity and diaphragm into the pleural cavity and lungs. They can appear in lymph nodes or skin (creeping tumors), liver or other abdominal organs, and the brain. They develop into adult form in tissue capsules laid down by the host in these various locations.

There is almost always a high eosinophilia in the pleural effusions. Peripheral blood commonly shows a leukocytosis with considerable eosinophilia. Slight elevation of blood sedimentation rate may occur but is not a constant finding. Eosinophilia in the cerebrospinal fluid may differentiate the cerebral complication from other central nervous system disease.

Four illustrative cases are described.

Twenty-six roentgenograms; 4 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Localized Fibrous Mesothelioma of the Pleura. O. Theron Clagett, John R. McDonald, and Herbert W. Schmidt. J. Thoracic Surg. **24**: 213–228, September 1952.

The authors review some of the conflicting opinions regarding tumors of pleural origin as reported in a rather extensive literature. More recently some clarification of these tumors has been made and it now seems reasonable to divide tumors arising from the pleura into two distinct groups. The first but less common group consists of localized tumors resembling fibromas or fibrosarcomas; the second group includes tumors of a diffuse nature involving the entire pleura, both parietal and visceral. The localized tumors comprise many histologic types, both benign and malignant. They originate from the tissue beneath the superficial lining cells of the pleura, in contradistinction to the diffuse tumors, which arise from the surface lining. Aside from their common origin from the pleura the two groups are entirely different, in regard to microscopic characteristics, clinical manifestations, treatment, and prognosis. The authors use the designations "localized fibrous mesothelioma" and "diffuse malignant mesotheliomas."

No accurate figures were found in the literature to indicate the true incidence of localized fibrous mesotheliomas. The authors report a series of 24 cases, 14 in men and 10 in women, with operation in all. The average age was forty-nine years.

Roentgenographic studies disclosed the presence of an intrathoracic lesion and provided important information regarding the site and size of the tumor in every instance. The roentgen examination, however, did not furnish any basis upon which these tumors might be distinguished from a variety of other intrathoracic neoplasms. The tumors varied from 4 to 36 cm. in diameter and from 50 to 5,000 gm. in weight.

In a number of cases the tumors produced no symptoms and were discovered incidentally on routine chest films. Several patients with large tumors complained of dyspnea, but this was not often a prominent symptom. Loss of weight was rare. Thoracic pain did not occur in any case. Clubbing of the fingertips or toes, or both, sufficient to attract the attention of the physician, occurred in 11 patients, and minor degrees of clubbing may well have been present in others. Sixteen of the 24 patients had symptoms or physical find-

ings referable to the joints. The articular manifestations consisted of pain and swelling, often indistinguishable from rheumatoid arthritis. The hands, ankles, shoulders, and wrists were the most frequent sites of involvement. In 7 cases there was a history of recurrent episodes of chills and fever.

As accurately as could be determined, the tumor arose from the visceral pleura in 18 cases and from the parietal pleura in 6. There were 4 known postoperative recurrences, 2 within six months, 1 after four years, and 1 after eight years, with a fatal outcome in all. Grossly, all the tumors were encapsulated and somewhat lobulated. Necrosis and hemorrhage were present in only one case, the only one in which histologic examination disclosed undeniable evidence of malignancy. Histologically the sections showed variation in cellular pattern. Some areas were relatively acellular and contained dense bundles of collagen, while others were very cellular.

From the roentgenologic point of view, the importance of this study lies in the absence of characteristic roentgen features to distinguish these localized tumors from any other similar appearing intrathoracic tumor. The diagnosis of localized fibrous mesothelioma of the pleura can be considered in the presence of almost any solitary intrathoracic tumor which does not show calcification, especially in a location at or near the periphery. The final diagnosis, however, must be made histologically.

Nine figures including 5 roentgenograms; 1 table.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

So-Called Pleural Thickening and Treatment of Chronic Pleuritis. A. Brunner. Schweiz. med. Wchnschr. **82**: 1049–1053, Oct. 11, 1952. (In German)

Although as early as 1934 the author demonstrated that broad indistinct cloudiness of a lung field is due for the most part to fluid accumulation in the pleural space, the erroneous diagnosis of pleural thickening is still frequent in such cases. Pleural thickening will show a definite shadow in the roentgenogram only if hit by the x-rays in tangential direction. The fact that findings may persist over long periods, occasionally over decades, without any symptoms, is frequently used in favor of the diagnosis of pleural thickening. It must be remembered, however, that pleural effusion may also persist over many years without producing symptoms. Several cases are presented, with accompanying roentgenograms, in which an x-ray diagnosis of pleural thickening had been made but which on operation showed the presence of pleural effusion or emphysema. In view of the permanent danger of infection and perforation, the correct diagnosis is of paramount importance. If pleural puncture is unsuccessful, decortication is advised.

Twelve roentgenograms; 2 photographs.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Pulmonary Embolism. Experimental Angiocardiographic Study. Roger P. Lochhead, Douglas J. Roberts, Jr., and Charles T. Dotter. Am. J. Roentgenol. **68**: 627–633, October 1952.

In investigating the cause of pulmonary arterial hypertension following pulmonary embolism, the authors have made angiocardiographic studies of the anatomical changes occurring in the right heart and pulmonary arteries after the production of experimental pulmonary embolism.

In each of 6 dogs an embolus was formed by clamping both ends of an exposed jugular vein and injecting 0.4 c.c. of thrombin solution into the blood-filled segment. A clot was palpable within a few minutes. Angiocardiography was done prior to release of the clot and at intervals of thirty seconds and one, two, three, four, and five minutes thereafter. A Fairchild roentgen-ray roll-film magazine was employed and films were made in the left anterior oblique projection following rapid injection of 8 to 12 c.c. of Neo-iopax (75 per cent).

One of the dogs died one minute after embolization. Complete angiocardiographic observations were obtained on the remaining 5. The location of the clot was definitely identified in 3 and was reasonably certain in the other 2. In most cases the occlusion was not complete; the emboli were located in the smaller lobar or segmental arteries, always in the lower lobes.

The most striking finding of the study was the demonstration of pulmonary arterial dilatation beginning at thirty seconds and lasting throughout the period of angiocardiography. The dilatation proved to be reversible in one of the animals which was subsequently re-examined, and was not invariably fatal.

The authors postulate that the dilatation was the result of right ventricular and pulmonary arterial hypertension, but the mechanism of this hypertension remains unexplained.

Twelve roentgenograms; 1 graph.

DORIS E. PIPKIN, M.D.
Louisville General Hospital

Asymptomatic Arteriovenous Fistula of the Lung. Report of a Case with Surgical Cure. Theodore J. Talbot and Jacob J. Silverman. Arch. Int. Med. **90**: 569–574, October 1952.

In the diagnosis of pulmonary arteriovenous fistula a great deal of stress has been placed on a group of characteristic signs and symptoms. The triad of cyanosis, clubbing of the fingers and toes, and polycythemia has been particularly emphasized. Attention also has been directed to the hereditary nature of this disorder, since in many cases it is associated with multiple hemangiomata of the skin and mucous membranes and a history of hereditary epistaxis is frequently obtained. A continuous extracardiac murmur, with accentuation of both systolic and diastolic phases at the height of deep inspiration, is indicative of an arteriovenous fistula. The angiocardiographic picture is diagnostic.

It is now becoming evident, however, that not all patients with arteriovenous fistula present characteristic signs and symptoms. In the case presented here an arteriovenous fistula in the lingular branch of the left upper lobe was accidentally discovered during a routine roentgenographic survey of the chest. The patient had no signs or symptoms referable to this lesion. The diagnosis was established preoperatively by the use of tomograms, which demonstrated abnormal vessels leading to and from an aneurysmal sac.

The authors believe that tomography has not been sufficiently stressed. It is recommended whenever a pulmonary arteriovenous fistula is suspected.

Three roentgenograms; 1 photograph in color; 1 table.

HOWARD L. STEINBACH, M.D.
University of California

Asymptomatic Pulmonary Arteriovenous Fistula: Report of Two Cases Surgically Treated. Martin J. Freedman, Nestor M. Hensler, and Byron E. Pollock. Am. Heart J. **44**: 594–599, October 1952.

Pulmonary arteriovenous fistula, thought to be a rare entity, is being recognized with increasing frequency. At least 69 documented cases have now been recorded in the literature. Two asymptomatic cases, diagnosed clinically and treated surgically, are reported with a view to analysis of clinical features.

Pathologically, the fistula consists of one or more aneurysmal dilatations in the lung parenchyma, representing an extension of a pulmonary artery which is connected by numerous fistulous vascular channels to a dilated vein. Lesions may occur in any lobe of the lung and are multiple in the majority of cases.

Although many cases of pulmonary arteriovenous fistula may be discovered clinically by the careful observer, the chest roentgenogram is a most valuable diagnostic aid. Usually the fistula is apparent as a round or lobulated density with sinuous linear shadows representing dilated tortuous afferent and efferent vessels coursing toward the hilus. Pulsation of the lesion and change in its size during the performance of the Valsalva or Müller maneuver may be observed on fluoroscopy. Because of the probability of multiple lesions, angiocardiography is indicated in all cases in which surgery is contemplated. A second smaller pulmonary fistula was not diagnosed preoperatively in one of the authors' cases; had angiocardiography been performed, it is conceivable that this lesion might have been discovered. This procedure is also of value in outlining the related vascular elements. Pulmonary arteriovenous fistula may be differentiated from congenital heart disease in that the bruit of the former is extracardiac, it changes in intensity with the respiratory phase, and is usually associated with a heart of normal size. Polycythemia vera may be excluded by the absence of splenomegaly and leukocytosis and lack of immature cells in the peripheral blood. Tumors, cysts, and inflammatory lesions of the lungs may be ruled out by utilization of the radiologic technics outlined.

In the authors' cases, the decision to remove the lesions was made after careful evaluation of the potentially dangerous consequences of prolonged observation. The facility with which the fistulous areas were resected and the rapid, uneventful recovery support the validity of the surgical approach.

Two roentgenograms; 2 photographs.

Traumatic Saccular Aneurysm of the Thoracic Aorta. R. K. Hollingsworth, William W. Johnston, and James F. McCooey. J. Thoracic Surg. **24**: 325–343, October 1952.

The authors present 4 cases of saccular aneurysm of the aorta, 3 of which were proved surgically. All followed blunt trauma to the chest, in motor accidents. Particularly interesting from the roentgenologic point of view is Case 1, in which chest films were obtained demonstrating the very beginning of the aneurysm, manifested by a small density parallel to and outside the descending aorta, before the diagnosis was suspected. In another case the aneurysm was undetected for a full year after the accident and was eventually discovered on a routine chest film. In view of this, it is urged that in all cases of injury to the thorax, especially of the anterior part, repeated follow-up films be obtained for two or three months after the accident.

In the cases reported, the aneurysms involved the first portion of the descending aorta, and this is the usual site, but those occurring in the ascending aorta are of equal importance. Both of these sites are relatively fixed points, the former by the fibrous union between the aorta and the pulmonary artery, and the latter by the ligamentum arteriosum and the large vessels. It is thought that the fixing of the aorta at these points makes tearing or rupture more likely when a sudden increase in pressure is forced upon them.

The authors discuss several theories of the pressure changes and the types of injury produced as reported by various authors. They also discuss treatment of aneurysms and aortic injuries. With the increase in violent trauma in our mechanical age, it is important that physicians, especially roentgenologists, be alerted for prompt recognition of traumatic aneurysms of the aorta, since treatment apparently is more successful if the lesion can be attacked early. Angiograms have been of great value in arriving at a correct diagnosis. Fluoroscopy may or may not give additional information but should be used as an adjunct diagnostic aid.

Twenty roentgenograms; 2 photographs; 1 drawing.

C. J. CORRIGAN, M.D.
St. Paul, Minn.

Coarctation of the Aorta. M. McGregor and M. Medalie. Brit. Heart J. **14**: 531–533, October 1952.

An unusual type of coarctation of the aorta is reported in an 8-year-old boy. Both subclavian arteries arose below the site of coarctation and both carotids above. This resulted in severe cephalic hypertension but poor circulation in the rest of the body. Pulses in all four limbs were absent, and there was no evidence of collateral blood supply to the lower extremities. The most striking feature on examination was the prominence and tortuosity of the carotid vessels. The fundi showed the features of hypertensive retinopathy. Roentgenograms demonstrated left atrial enlargement. In the right anterior oblique view an indentation of the posterior wall of the barium-filled esophagus confirmed the presence of an anomalous right subclavian artery, while in the left anterior oblique view enlargement of the left ventricle was observed.

Angiocardiographic studies were made in preparation for surgery. At the first attempt, no filling of the distal segment was obtained. A second intravenous injection was therefore made, simultaneous with injection from a catheter in the distal segment introduced *via* the femoral artery. With this procedure, there was adequate filling of the descending aorta, which appeared normal, and it could be seen that the coarcted segment was extremely short, rendering an aorta graft unnecessary. The subclavian arteries did not appear to fill from either the upper or the lower segment.

Surgery was attempted but death occurred on opening the thorax. Postmortem studies showed, in addition to the other findings, a barely patent ductus arteriosus.

Three roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Functional Aspects of Congenital Defects Affecting the Left Ventricle. Klara J. Prec and Donald E. Cassels. J. Pediat. **41**: 451–461, October 1952.

A series of patients, each representing one of the three categories of abnormality of outflow from the left

ventricle at different levels, offered opportunity for observations of some functional aspects of the left heart syndrome. The 3 patients showed, respectively, (1) fibroelastosis involving the left ventricle only, (2) stenotic obstruction of the area of the aortic valve and (3) hypoplasia of the arch of the aorta associated with a patent ductus arteriosus. The cases reported represent an impediment at different anatomical levels in the course of blood flow from the left ventricle. Difficulty in outflow, resulting from disease of the ventricle itself, was best demonstrated by angiocardiography, in which case there was delay and difficulty in systolic expulsion. Even after the left ventricle was completely opacified, none of the opaque material appeared in the aorta. Obstruction to outflow in the area of the aortic valve manifested itself functionally by angina, the myocardial ischemia being identified only by the electrocardiogram after exercise, the resting tracing being normal. Obstruction to flow in the aorta resulting from aortic hypoplasia produced progressive pulmonary congestion, the functional aspects of which were followed by serial determinations of arterial oxygen saturation.

Ten roentgenograms; 2 photographs; 1 ballistocardiogram; 1 electrocardiogram.

HOWARD L. STEINBACH, M.D.
University of California

The Roentgenological Aspects of Heart Catheterization. Normal and Abnormal Positions of the Catheter Within the Heart. Joseph Jorgens, John LaBree, Forrest Adams, and Leo G. Rigler. Am. J. Roentgenol. **68:** 610–618, October 1952.

Postero-anterior and lateral films should be routinely obtained to determine the position of the catheter during cardiac catheterization. In over 300 catheterizations performed at the University of Minnesota Hospitals, many examples of the usefulness of this procedure have been obtained. The authors discuss and present films to show the presence of the catheter in anomalous pulmonary veins, in the coronary sinus, through interatrial septal defects, from the right ventricle into an overriding dextroposed aorta, etc. In many of these examples the lateral film was necessary to make the correct diagnosis. In some cases the pressures and physiological studies obtained were not conclusive, while the definite passage of the opaque catheter through an interatrial defect or through a patent ductus made the diagnosis certain.

No serious complications occurred. In one case a looped catheter, lodged in the inferior vena cava, was rather difficult to remove. In another case spasm of a pulmonary vein had to be overcome by injection of a novocaine solution.

The authors were able to pass a catheter from the pulmonary artery through a patent ductus into the aorta in 7 out of 31 patients. The catheter was also passed from the right atrium into the left atrium in 21 of 38 patients proved to have an interatrial septal defect. It must be remembered, however, that a catheter may enter the left atrium through a patent foramen ovale, as well as through an interatrial septal defect. The presence of a dextroposed aorta was proved in 16 of 45 cyanotic patients suspected of having an overriding aorta.

Twenty roentgenograms; 2 drawings.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Radiologic Methods in the Diagnosis of Cardiac Aneurysm. Efrén Guillermo Jurado López. Radiología (Panamá) **2:** 43–48, December 1951.

The purpose of this communication is to emphasize the importance of the systematic utilization of the various radiologic procedures in the relatively rare aneurysm of the heart, the recognition of which is so important for treatment and prognosis. The author finds fault with the term aneurysm in these cases, since one is dealing not with saccular or fusiform dilatations of a vessel but rather with passive parietal dilatations of the ventricle. Usage has, however, confirmed the term cardiac aneurysm.

The diagnosis can be made with assurance only by radiologic methods—fluoroscopy, roentgenography, kymography, tomography, and angiocardiography. All of these procedures may be needed on occasion. Spot films are valuable and sufficient in some cases, supplementing the screen study. The levogram in the course of angiocardiography offers the surest proof of cardiac aneurysm. It is only necessary to be cautious and systematic, realizing that for the success of a roentgenologic examination one should not depend upon any single technic.

Five roentgenograms.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

Eventration of the Diaphragm. William C. Beck and Dominic S. Motsay. Arch. Surg. **65:** 557–563, October 1952.

The authors state that eventration of the diaphragm is a congenital aplasia, either partial or complete, of this muscular organ. It is much more common than is generally supposed. It permits protrusion of the abdominal viscera into the chest and in infants the lung compression and mediastinal displacement may cause symptomatology sufficient to require surgery. Respiratory difficulty with dyspnea and cyanosis is the cardinal sign.

Recognition of this entity is simple. Routine chest films are usually pathognomonic, and the authors suggest that more widespread roentgenography of infants will lead to more frequent recognition of the condition.

The differential diagnosis from congenital atelectasis or congenital traumatic phrenic nerve paralysis is generally simple or, in the case of congenital diaphragmatic hernia, academic, since surgical correction is the same for both. Treatment, necessary only if symptoms are severe, consists of surgical plication of the diaphragm either by way of an abdominal or thoracic approach. The results are uniformly good.

Four roentgenograms.

PAUL MASSIK, M.D.
Quincy, Mass.

Diaphragmatic Hernia in the Newborn. E. K. Johnson and J. L. Mangiardi. Am. J. Dis. Child. **84:** 436–438, October 1952.

A case of paraesophageal hiatus hernia, such as is usually seen only in the adult, was observed in a newborn infant. A chest film showed a gas-filled viscus in the mediastinum to the right, dorsally to the heart. The diagnosis was confirmed by an esophagram, and the hernia was successfully repaired.

This is believed to be the fifth reported case of paraesophageal hernia in infancy and the first in the newborn.

Two roentgenograms.

THE DIGESTIVE SYSTEM

Cardio-Chalasia in Infancy, with A Review of the Literature, Report of a Case, and a Suggested Method of Treatment. W. Davies. J. Pediat. **41:** 467–472, October 1952.

Cardio-chalasia refers to a condition in which there is a relaxation of a cardiac sphincter, allowing regurgitation of the gastric contents into the esophagus. This condition can be diagnosed only by roentgenoscopy, during which a barium meal can be observed to pass from the cardia of the stomach into the esophagus when the patient is placed in the Trendelenburg position.

Treatment should be conservative, with frequent thickened feedings, with added alkalis if there is any evidence of esophagitis or ulceration, and the maintenance of an upright posture for periods after feedings, or preferably throughout the whole twenty-four-hour period.

A case in an infant with a history of vomiting from birth is reported.

One roentgenogram; 2 photographs; 1 graph.

HOWARD L. STEINBACH, M.D.
University of California

Iodized Oil Aspiration in the Newborn. John DeCarlo, Jr., Arnold Tramer, and Henry H. Startzman, Jr. Am. J. Dis. Child. **84:** 442–445, October 1952.

The authors undertook an investigation on 100 healthy infants twelve to twenty-four hours old to throw light on the aspiration of iodized oil used in roentgenoscopy in the early neonatal period. After a preliminary roentgenoscopic survey of the chest and abdomen, the infants were fed varying amounts of chloriodized oil (Iodochloral) and the course of the medium was followed to the stomach.

Aspiration of the oil was observed in 13 per cent of the infants. This occurred usually on swallowing the third or fourth bolus of contrast medium. None of the infants aspirated barium sulfate, which was also fed to those observed to aspirate the iodized oil.

Of the 13 infants who aspirated the oil within the first twelve hours, 4 continued to aspirate, as shown by repeat studies at twelve and twenty-four hours. Two infants continued to aspirate beyond one-hundred-forty-four hours.

It is considered probable that such aspiration is due to neuromuscular immaturity and the low surface tension of iodized oil. Because of the confusion which may arise from aspiration of oil by normal infants, the authors suggest that iodized oil is of limited value in early diagnosis of tracheo-esophageal fistulas.

Three roentgenograms.

DORIS E. PIPKIN, M.D.
University of Louisville

Significance of Intra-Abdominal Calcification in the Newborn Infant. C. T. Kasmersky and William H. R. Howard. Am. J. Roentgenol. **68:** 395–398, September 1952.

The authors report the case of a newborn infant with clinical and roentgenologic signs of high intestinal obstruction in which calcifications were observed in the left half of the abdomen. The findings were interpreted as representing small intestinal obstruction and fetal meconium peritonitis. Surgical exploration revealed six atretic segments in the mid jejuno-ileal region. There was no evidence of peritonitis or peritoneal calcifications. Resection and side-to-side anastomosis between the proximal jejunum and upper ileum was accomplished. Postoperatively, signs of obstruction persisted and roentgenograms revealed findings similar to those observed earlier, except for the fact that the calcifications in the left abdomen were absent. Roentgen studies of the resected bowel revealed calcification in the specimen. Microscopic examination with von Kossa's stain showed the calcification to be confined to the lumen. At necropsy no calcification was observed in the peritoneal cavity. A generalized fibrinous peritonitis was present, thought to be due to leakage at the anastomosis.

This case indicates that intra-abdominal calcification is not necessarily pathognomonic of fetal meconium peritonitis.

Four roentgenograms; 1 photomicrograph.

J. H. GROVE, M.D.
Mt. Sinai Hospital of Cleveland

Lymphosarcoma of the Gastrointestinal Tract. Ira H. Lockwood. J.A.M.A. **150:** 435–437, Oct. 4, 1952.

Lymphosarcoma is the most common lymphoid tumor of the intestinal tract. It may be local or part of a generalized disease. Symptoms may arise from extrinsic pressure by enlarged retroperitoneal and mesenteric nodes, from projecting polypoid growths, or from lesions infiltrating the wall. Colicky pain occurs early due to involvement of the submucosal plexuses. Obstruction is usually chronic but occasionally is acute, due to intussusception. Anemia, weight loss, and achlorhydria are common symptoms.

There are no pathognomonic roentgenologic signs of lymphosarcoma, but some findings are characteristic. A diffusely infiltrating lesion in the distal stomach of a young person is suggestive. Exaggerated, stiff rugae with diminished peristalsis and fixation are other signs. The disease may be present without roentgen manifestations. Polypoid growths simulate carcinoma.

Most lymphosarcomas of the small bowel are in the terminal ileum, making differential diagnosis difficult. There may be multiple sites of involvement. Irregular dilatation of the involved segment is the rule, instead of constriction as in carcinoma. Also, a longer segment of the intestine is usually involved. Localized masses of intestine or mesentery may attain great size.

Lymphosarcoma of the large bowel is rare. It is usually polypoid and is considered to be carcinoma until after biopsy. Rectal lesions are readily diagnosed by biopsy.

Surgical removal of the primary lymposarcoma and adjacent nodes, followed by irradiation, is the best treatment. Exploratory laparotomy is always indicated, even where operability is questionable on the basis of the roentgen findings, as the tumor tends to remain localized for a long period, metastasizing much later than carcinoma. Metastasis *via* the lymphatics makes irradiation over the area of involvement and its lymphatic drainage essential for cure. Cecal lesions give the best five-year-cure rate. Recurrence is highest in the small intestine. Inoperable lesions and recurrences usually respond well to irradiation, with rapid decrease in size of tumor and clinical improvement. Nitrogen mustard is of limited value when the lymphosarcoma has become radioresistant. Radioactive isotopes have not been effective.

Four representative cases from a series of 100 are presented to illustrate the fact that, while the ultimate prognosis is grave, close observation and repeated ir-

radiation may give many comfortable, symptom-free years of useful life following initial surgical extirpation.

Twelve roentgenograms; 3 photomicrographs.

GEORGE A. SHIPMAN, M.D.
New Orleans, La.

Hypertrophic Pyloric Stenosis. Symptomatology. Report of a Typical Case Treated Surgically. Feliz Perez Hurtado and R. A. Ochoa. Rev. cubana pediat. **24:** 537–543, September 1952. (In Spanish)

Because of the increasing frequency of hypertrophic pyloric stenosis, the author feels that the report of this case is worth while, giving an opportunity to review the findings. The signs and symptoms include: projectile vomiting of undigested food, commencing in the second or third week, with no bile in the vomitus; at times a palpable pyloric tumor; a scaphoid lower abdomen; scanty bowel movements every two or three days; loss of weight; general muscular depreciation. The hypertrophy is seen at autopsy as early as the first week, leading to the conclusion that it is a hypertrophic stenosis of congenital origin with secondary spasm. The hypertrophy and the spasm are not inseparable; pyloric spasm without hypertrophy or hypertrophy without spasm may be encountered. The roentgen findings are discussed in some detail but without the attention to details of the pyloroduodenal region which have been stressed in recent years. The diagnosis apparently depends upon the gastric retention, plus absence of opaque material in the small bowel in the early observations and the presence of only a small quantity of barium in the small bowel in the later tests.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

Prolapsing Gastric Mucosa: A Review of 117 Cases in a Private Practice. McClaren Johnson. J. M. A. Georgia **41:** 439–455, October 1952.

The author discusses fully the various aspects of prolapse of the gastric mucosa, based on a review of the literature and a series of 117 cases seen in private practice in a three-year period. The purpose of his presentation is to dispel some of the confusion and disagreement which now exist in regard to the disorder. He reaches the following conclusions:

Prolapse of the gastric mucosa through the pylorus is a fairly common condition. Its recognition often explains symptoms hitherto unexplained and may result in the rehabilitation of the patient. It is often associated with duodenal ulcer, and the prolapsed membrane itself may ulcerate. It has been the cause of massive hemorrhage. There is no evidence at present that prolapse of the gastric mucosa predisposes toward malignant change. Only 1 such case has so far been reported.

The duodenal bulb is usually smooth and rounded, but the base has an invaginated appearance, characterized by deep cupping and described as umbrella- or mushroom-shaped. In some cases it resembles a water spout. The defect should involve both sides of the bulb. If only one side is involved, the possibility of a polyp must be considered. Often the rugal lines of the extruded mucosa can be traced through the pylorus and into the base of the duodenal cap.

In the majority of cases symptoms are relieved by medical treatment. It is essentially that for duodenal ulcer, and should be tried as long as possible before resort to surgery. Patients who can wait should be advised to do so in the hope that accumulation of more information may lead to greater assurance as to the proper decision. In some instances prolapse of the gastric mucosa produces symptoms of sufficient magnitude to justify surgery. If unavoidable, operation should probably be limited to some form of pyloroplasty. If other conditions call for subtotal resection, they, and not the prolapse, should dictate the choice of procedure.

Thirty-one roentgenograms; 3 photographs; 7 tables.

Aneurysm of the Left Gastric Artery. A Case Report. Kirk H. Prindle and George W. Magladry. Surgery **32:** 123–125, July 1952.

Aneurysm of the left gastric artery is exceedingly rare, only 1 case having been recorded in the American literature during the last twenty years (Mass. General Hosp. Case 32402. New England J. Med. **235:** 524, 1946). The authors present a case in a 68-year-old man with vague gastrointestinal symptoms and persistent occult blood in the stool. X-ray examination revealed a constant gross filling defect, quite irregular in outline, in the upper half of the stomach on the lesser curvature. Cytologic examination of gastric washing specimens was negative for malignant cells. Nevertheless, on the assumption that a carcinoma of the stomach was present, laparotomy was done. The exact nature of the disorder was not fully realized until the stomach was explored and the mucosa found to be intact. Then, by placing the fingers in the stomach and the thumb in the lesser omental cavity, it was possible to recognize a pulsatile lesion. It was adherent high on the lesser curvature and was found to be an aneurysmal dilatation of a blood vessel, which proved to be the left gastric artery The aneurysm was resected and the stomach closed. Three months postoperatively, the patient's symptoms had disappeared.

Two roentgenograms.

The Problem of Diagnosis of Duodenal Tumors. I. Golyi, F. Indrak, and K. T. Veselyn. Acta radiol. et cancerol. bohemoslov. **6:** 43–58, Oct. 31, 1952. (In Russian)

The authors describe the clinical findings and the x-ray appearance in 4 cases of tumor involving the duodenum and in a fifth case in which intussusception of the pylorus into the duodenal bulb simulated a duodenal tumor.

In the first patient, a 76-year-old woman, suffering for about ten years from pernicious anemia treated by liver extract, roentgenograms showed a rounded filling defect in the second portion of the duodenum in the region of the papilla of Vater, apparently signifying a large benign tumor originating from the pancreas. As the patient refused operation, this diagnosis could not be confirmed.

In the second case, that of a 33-year-old man, two polypoid lesions were diagnosed radiologically in the descending ramus of the duodenum in the neighborhood of the papilla of Vater. In view of the marked gastrointestinal symptoms, and in order to ascertain the true character of the lesions, operation was performed, during which gallstones were found and pathologic changes were seen in the pancreas. Two small tumors in the duodenum, corresponding to the x-ray findings, were surgically removed. Considerable bleeding was observed in the pancreatic tissue. Two days after opera-

tion the condition of the patient deteriorated and he died. On autopsy considerable hemorrhagic necrosis of the pancreas was found. Pathologic examination of the duodenal tumors showed that they consisted of displaced pancreatic tissue in the duodenal wall.

The third and fourth cases were of primary carcinoma of the gallbladder. The third patient, a 56-year-old man who had experienced gallbladder attacks for about twenty-five years, showed marked narrowing of the second part of the duodenum due to the gallbladder tumor and a fistulous communication between the duodenum, the biliary passages, and the colon. The x-ray diagnosis of carcinoma of the gallbladder extending into the neighboring organs and producing the pathologic communications described above, as well as cholangitis, was confirmed at autopsy. The fourth patient, a 57-year-old man, complained of indigestion, loss of weight, constipation, and blood in the stools. X-ray examination showed the duodenal bulb elongated and deformed. The remaining portion of the duodenum was widened and showed filling defects over the medial aspects. Serial radiography demonstrated radiation of the contrast medium in the direction of the liver shadow. The x-ray diagnosis was carcinoma involving the descending portion of the duodenum, probably originating in the gallbladder; perforation into the region of the subhepatic region and communication with the biliary tract. The patient died five months after x-ray examination but autopsy was not performed.

ERNEST A. SCHMIDT, M.D.
Denver, Colo.

Duodenal Stenosis by Annular Pancreas. Th. Johner. Schweiz. med. Wchnschr. **82**: 1060–1062, Oct. 11, 1952. (In German)

A 37-year-old woman for about seven years had been complaining of spasmodic gastric pains five to ten minutes after eating. X-ray examination showed a marked stenosis in the descending ramus of the duodenum. Translucent shadows in the region of the duodenal bulb had the appearance of cherry pits. The bulb itself was markedly enlarged. Some gastric residue persisted after six and one-half hours. Radiologically the cause of the stenosis could not be definitely ascertained, but operation showed the stenotic area almost completely surrounded by pancreatic tissue. Cherry pits were found in the duodenal bulb. After plastic enlargement, analogous to the Finney operation, the patient made an uneventful recovery. Four and one-half months after operation the duodenal bulb still appeared enlarged but there was no evidence of stenosis in the duodenum.

As shown by this case, complete ring formation by an annular pancreas is not necessary for the production of stenosis, nor is simple division of the pancreatic ring always sufficient to eliminate the stenosis and relieve the symptoms.

Five roentgenograms; 1 drawing.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Some Functional Disorders of the Small Intestine of Clinical Importance. Carman Lecture. Ross Golden. Minnesota Med. **35**: 930–937, October 1952

Diseases or disorders of the small intestine may be discovered incidentally during a radiologic examination of the stomach and duodenum or, in rare instances, during an examination of the colon. The best way to study the small intestine by x-ray is to follow a barium suspension through its entire length by films at regular intervals and fluoroscopic observations.

The three major indications for a small-intestine study are (1) diarrhea, (2) intestinal bleeding, and (3) abdominal pain, particularly in the periumbilical region or the right lower quadrant, assuming that disease in the more common sites has been ruled out.

The author presents an interesting discussion of the motor physiology of the small intestine which seems to have a bearing on the phenomena demonstrated by radiologic methods. Examination of the small intestine by x-rays gives information as to the transit time, width of the lumen, and other less important manifestations of motor function.

Psychosomatic diarrhea, functional intussusception, and allergic reactions in the small intestine are disorders consistent with parasympathetic overactivity. Parasympathetic inhibition is brought about by the use of Banthine, which produces hypotonicity and considerable slowing of the transit time through the small intestine in addition to reducing the gastric secretion.

Occasionally, patients are seen who have a slow transit time through the small intestine, and in such cases Urecholine, a parasympathomimetic drug, has a definite stimulating effect.

Sympathetic overactivity and intestinal disorders may occur as a result of overactivity of the sympathetic or insufficiency of the parasympathetic. No satisfactory sympathetic inhibitor, such as Banthine for the parasympathetic system, is available, however.

Gas distention may result from a number of causes which apparently inhibit movement by depressing the effect of the parasympathetic system, one example being pain associated with acute peritonitis, which stimulates the sympathetic system. Scleroderma, amyloidosis, and carcinoma of the mesentery are organic diseases that also produce distention.

The author stresses the fact that familiarity with certain aspects of motor physiology is a necessary approach to an understanding of some of the disorders of the small intestine encountered on x-ray examination. Neuromuscular physiology and the chemical mediation theory are particularly important.

Eight roentgenograms; 1 photomicrograph.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

The Small Intestine Pattern in Coeliac Disease. Charlotte M. Anderson, R. Astley, J. M. French, and J. W. Gerrard. Brit. J. Radiol. **25**: 526–530, October 1952.

The small intestines of 19 children with proved celiac disease were examined with the aid of a simple suspension of barium in water and a stabilized suspension resistant to flocculation by mucus.

When the simple suspension was used, there was so much clumping that the examination was not significant. With the flocculation-resistant suspension, small-intestine dilatation was found and changes in the mucosal pattern were seen. There was no measurable correlation between the clinical severity of the disease and the extent or degree of changes seen on radiography.

The observed changes disappeared with recovery.

Nine roentgenograms; 2 charts.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Technic of the Double Contrast Examination of the Colon. Clyde A. Stevenson. S. Clin. North America **32**: 1531–1537, October 1952.

The author presents a technic of double-contrast examination of the colon in which it should be possible to detect the presence or absence of any neoplastic lesion more than 2 mm. in diameter in about 85 per cent of all patients.

Methods of bowel preparation were studied and castor oil, 30 c.c., was found to be most effective, with phenophthalein being second and compound licorice powder third. The following preparation is recommended: (1) No supper. (2) One ounce castor oil at 7 P.M. (3) Three warm soapsuds enemas (1 quart each) at fifteen-minute intervals beginning the next morning at 6 A.M. (4) Light breakfast at 7 A.M. (5) Colon examination at 8 A.M.

Two barium preparations have proved satisfactory: IX Barium, 7 pounds to 12 pints of water, and Sta-Barium, 5 pounds to 12 pints of water. For mixing, a minimum of ten minutes is required; twenty are preferable. The suspension must be adjusted to body temperature.

The barium is allowed to flow unhindered from a height of 3 feet under fluoroscopic observation until a point between the splenic flexure and mid-transverse colon is reached. This step should not consume over thirty seconds. The patient is then taken to the toilet and allowed no more than one minute for evacuation. Air is then introduced under fluoroscopic control by means of a Weber insufflator. The colon is distended to at least its normal size by rapid introduction of small amounts of air. As quickly as possible stereoscopic roentgenograms are made with the patient supine and prone. The change in position moves the fluid barium suspension about so that a double-contrast visualization of the entire colon is possible.

An alternative method, which may be used in children and incapacitated adults, is described. A "Y" tube is employed and the barium allowed to run not quite to the splenic flexure. Air is then injected without permitting evacuation.

Technical difficulties encountered which require reexamination or change in technic are also listed.

Eight roentgenograms. DORIS E. PIPKIN, M.D.
University of Louisville

Pneumocholecystitis. Aaron Schwinger, Samuel D. Hemley, and Leo A. Harrington. Gastroenterology **22**: 272–276, October 1952.

A case of pneumocholecystitis believed to be the twentieth in the literature is reported. The roentgen criteria of McCorkle and Fong (Surgery **11**: 851, 1942) were present, namely, (1) gas confined to the lumen of the gallbladder, (2) no fluid level on upright films, (3) no visualization of the duct system, and (4) gas present within the gallbladder wall. On this basis the diagnosis was made.

Four roentgenograms.

Cholecystography with Telepaque. Vernon L. Peterson. West Virginia M. J. **48**: 294–296, October 1952.

The author has used Telepaque in over 100 patients and finds that it produces a shadow in the gallbladder about 50 per cent more dense than that obtained with previously used media. Also there have been fewer complaints of nausea, vomiting, and diarrhea. In less than 6 per cent of the cases was a repetition of the examination necessary. A dose of 3 gm. was used, but more recently it has been found that in most instances 2 gm. is adequate.

Five roentgenograms.

Peritoneoscopic Cholangiography. German Abad Valenzuela. Acta radiol. Interamericana (Buenos Aires) **2**: 28–34, 1952. (In Spanish)

Valenzuela believes that peritoneoscopic cholangiography is in some cases even more satisfactory than when injection is made in connection with surgical procedures. It is possible to learn the anatomic condition and morphologic structure of the biliary tract, the localization of intrahepatic or extrahepatic stones, etc. The method is based on filling the gallbladder with opaque material.

Marcelle Royer of Argentina apparently was the first to make a direct injection into the gallbladder with opaque substance by the peritoneoscopic method. In association with Rizzo, Valenzuela has used equipment especially designed for laparoscopy, employing a double needle constructed for just such cases. A spinal puncture needle can be used if the double needle is not available. The gallbladder is located and then, under constant control of the peritoneoscope, the needle is introduced through the abdominal wall and guided into the gallbladder, withdrawing part of its contents. If the gallbladder should have sclerotic rigid walls or many pericholecystic adhesions, the method is contraindicated. For the injection the author uses Neo-Iopax diluted to 25 or 30 per cent, introducing 10 to 40 c.c. The radiographic technic is routine. If there is indication for surgery, it is recommended that the operation be done not later than the following day to avoid possible later complications, a thing which could happen after any kind of intervention. Ordinary cholecystography should precede the method here described.

JAMES T. CASE, M.D.
Santa Barbara, Calif.

THE MUSCULOSKELETAL SYSTEM

Gargoylism and Morquio's Disease. H. Zellweger, L. Giaccai, and S. Firzli. Am. J. Dis. Child. **84**: 421–435, October 1952.

The group of constitutional enchondral bone disturbances which appear after birth presents many difficulties in classification and diagnosis. The authors quote several classifications proposed by various authorities. Their paper is concerned with the difficulties of diagnosing abortive and late forms of gargoylism. In such cases it is not always easy, and indeed may be impossible, to distinguish between gargoylism and Morquio's disease. The x-ray signs of the two conditions are listed [see accompanying table], but these cannot be taken as entirely typical. They are merely suggestive of the diagnosis under which they appear.

The fully developed picture of gargoylism includes: (*a*) short growth with stunted trunk, lumbar kyphosis and deformities of the sternal bone, short extremities with broad fingers, large skull with bulging parietal bones; (*b*) signs of lipoid storage, namely, hepatosplenomegaly, cloudiness of the cornea, mental deterioration, and abnormal granulations in white blood cells; (*c*) such accessory signs as gargoyle facies, flabby skin, frequent upper respiratory infections. The typical case is easy to recognize. However, some patients ex-

X-RAY SIGNS IN MORQUIO'S DISEASE AND GARGOYLISM

Region	Morquio's Disease	Gargoylism
Sella turcica	Normal	Enlarged, shoe form
Vertebral bodies	Platyspondyly with irregular epiphyseal plates	Hook form with beak-like protrusion of anterior edge, especially marked in the second and third lumbar vertebrae
Long bones	Normal diaphysis	Enlarged diaphysis tapering toward metaphysis
Epiphysis	Small, irregular, ill-defined, and fragmented	Bigger than in Morquio's disease
Carpal ossification centers	Normal or delayed maturation	Delayed maturation
Ribs	Normal	Spatulated, oar form

hibit only traces of storage syndrome and in some the corneae are clear. In some cases, as suggested above, the roentgen picture is easily confused with Morquio's disease. The x-ray changes in the earliest phases of gargoylism differ from those in later phases.

The authors present three cases in detail. In one, the skeletal changes were well developed at five years, but storage disease did not appear until four years later. Of the other 2 patients, a brother and sister, one had fully developed gargoylism at the age of nine; the other, two and a half years old, had typical skeletal changes, but minimal storage syndrome.

In none of the three cases reported here were the roentgenological changes described as characteristic for Hurler's disease fully represented. In Case 1, the x-ray changes were similar to those in pleonosteosis. In Cases 2 and 3 some of the characteristic signs of Hurler's disease were present, but in both cases the sella turcica was normal. Some long bones showed tapering from their ends, whereas some others showed wide flaring of the metaphyses. On this basis it is concluded that differential diagnosis between the various types of epimetaphyseal dysostoses based only on roentgen evidence is unreliable.

The use of a slit lamp is recommended, in order not to miss early corneal changes.

Six roentgenograms; 4 photographs; 4 photomicrographs.

LAWRENCE A. DAVIS, M.D.
University of Louisville

Clinical and Roentgenological Manifestations of the Klippel-Feil Syndrome (Congenital Fusion of the Cervical Vertebrae, Brevicollis). Report of Eight Additional Cases and Review of the Literature. Melvin I. Shoul and Max Ritvo. Am. J. Roentgenol. **68**: 369–385, September 1952.

The authors state that there have been approximately 65 cases of the Klippel-Feil syndrome reported in the English literature and an equal number in the foreign literature. To these they add 8 cases.

The most generally accepted opinion is that the syndrome is the result of a widespread failure of normal segmentation of the mesodermal somites. The clinical manifestations are produced by vertebral fusions, the multiple and varied congenital anomalies which accompany the syndrome, and the neurological disorders which ensue from torsion and compression of nerve roots. Erskine (Arch. Path. **41**: 269, 1946) stated that the most significant roentgen features comprise synostosis of the cervical vertebrae, flattening and widening of the vertebral bodies, narrowing or obliteration of the intervertebral disks, shortening of the cervical spinous processes, spina bifida, and fusions and deformities of the ribs.

The 8 cases here reported, in addition to fusion of the cervical vertebrae, present some of the more common associated anomalies, such as Sprengel's deformity, asymmetry of ribs and vertebrae, hemivertebra, and spina bifida. Two of the cases were associated with acute cervical injury. In one of these, sudden death occurred after a relatively minor trauma, and fractures across the base of the odontoid process and through the base of the skull into the foramen magnum were found at postmortem examination. It is believed that the fused vertebrae in the cervical spine increase the susceptibility to cervical fracture because of the limitation or absence of mobility. The other patient was a 28-year-old male who had complained of intermittent paresthesias of the back of the head and the neck for a number of years. Following a blow on the back of the head, pronounced weakness of the upper extremities, hyperactive knee and abdominal reflexes, and atony of the bladder developed. A fracture was not demonstrated in the cervical spine. Slow recovery ensued.

A third case with unusual features was one in which there were platybasia and narrowing of the foramen magnum, together with neurosyphilis. Subsequently right hemiatrophy and some anesthesias developed.

No therapy is apparently effective. Traction, remedial exercises, and manipulation may be utilized for symptomatic relief. The authors stress the importance of laminagraphy and of stereoscopic studies in determining the extent of the skeletal deformity.

Nineteen roentgenograms; 6 photographs; 1 drawing.

J. H. GROVE, M.D.
Mt. Sinai Hospital of Cleveland

Psoriatic Arthritis: Observations of the Clinical, Roentgenographic and Pathological Changes. Mary S. Sherman. J. Bone & Joint Surg. **34-A**: 831–852, October 1952.

Psoriatic arthritis is a definite clinical entity, peculiar to persons who have psoriasis. It has a predilection for the distal joints of hands and feet. The clinical and roentgenographic findings are characteristic and quite different from those of rheumatoid arthritis.

A study of 15 patients is reported. The diagnosis of cutaneous psoriasis in all of the cases was proved by skin biopsy. In the majority of patients the skin changes preceded joint changes by several years. In 2 patients, skin and joint symptoms began simultaneously. Nail involvement consistently preceded joint involvement. Although many patients had pains and aches in several joints, including the spine, objective clinical manifestations and x-ray manifestations in nearly all cases were limited to the hands, wrists, and feet. The major changes were in the distal joints.

The initial symptoms in a given joint developed either

insidiously or acutely. Once established, the joint syndrome tended to evolve in attacks with spontaneous remissions. Early in the course of the disease the joints showed a tendency to return to normal between attacks. Later there was almost always some permanent residual damage.

In most patients there was no correlation between the severity of the skin disease and the severity of the joint involvement. The exacerbations and remissions of skin and joint symptoms were not simultaneous. This finding is at variance with most reports. Involvement of the joints of the fingers and toes corresponded most closely to involvement of the nails. All patients had pain. Several were completely disabled.

While in an active phase of the disease, all patients showed an elevated sedimentation rate. Fever, leukocytosis, adenopathy, iritis, and cardiac changes were not seen. No patients showed subcutaneous nodules.

The absence in psoriatic arthritis of the subcutaneous nodules so common in rheumatoid arthritis is considered to be good evidence that these two conditions are of different etiology. In rheumatoid arthritis there is usually involvement of multiple joints at the onset. In psoriatic arthritis the process characteristically begins in one joint and progresses joint by joint. Roentgenographic study usually shows no great degree of bone atrophy even when the destructive changes are extensive. The earliest change is marginal erosion at the edges of the joint surfaces of the phalanges. Later, irregular destruction occurs along the shafts, causing a scalloped appearance of the cortex. Gross destruction of the bone ends may occur. Usually there is little bone repair. Ankylosis is rare. A predilection is shown for involvement of the distal interphalangeal joints of the fingers, with sparing of the metacarpophalangeal joints even in patients with wrist involvement. In the feet, the condition starts in the distal portions but soon involves all the joints up to and including the metatarsophalangeal joints.

Pathologic examination of tissue from involved joints reveals no pathognomonic pattern. The changes are constant but not sufficiently specific so that the diagnosis can be made with certainty from the microscopic examination alone. ACTH and Cortisone are used to induce remissions in psoriatic arthritis, but the improvement obtained is not permanent. Disabling deformities of the toes can be greatly relieved by surgery.

Seventeen roentgenograms; 8 photographs; 9 photomicrographs.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

The Course of Acute Hematogenous Osteomyelitis in Infants Receiving Penicillin Therapy. R. Garsche. Fortschr. a. d. Geb. d. Röntgenstrahlen **77**: 395–408, October 1952. (In German)

The author discusses the pathological process in hematogenous osteomyelitis in infants, dividing it into three stages: (1) bacterial invasion close to the metaphysis; (2) extension into a joint or, if the condition is extra-articular, between cortex and periosteum; (3) subperiosteal abscess emptying into the soft tissue or extending into the diaphysis and the bone marrow. Stage 1 (metaphyseal abscess) is difficult to diagnose roentgenologically; this phase may last eight to fourteen days. Most infants are seen during the second stage.

Penicillin may affect the course of the osteomyelitis in any stage and may abort the disease in Stage 1. If, however, the process continues to go on to Stage 3, complete bone regeneration—in the absence of other findings—is rather slow, due possibly to toxic damage caused by the antibiotic.

The mortality, which formerly ranged from 35 to 65 per cent, has been reduced to a minimum by the use of antibiotics.

The influence of Penicillin on the disease is demonstrated in several case reports supported by roentgenograms.

Fifteen roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

Skeletal Changes in Chronic Types of Leukemia and Their Recognition by X-rays. Václav Šváb and Eva Filsaková. Acta radiol. et cancerol. bohemoslov. **6**: 9–24, 1952. (In English)

A systematic examination of 18 patients with chronic lymphatic leukemia and 14 patients with chronic myeloid leukemia was made by means of roentgenography of the skeleton. All showed bone changes. These were of three general types: (1) hyperplastic (ossifying) periostitis and osteosclerosis, (2) bone destruction, (3) eccentric osteoatrophy.

The most frequent change is hyperplastic periostitis. This is usually circumscribed and often leads to thickening of the bone. It can occur in any of the long bones but is most frequent in the bones of the lower extremities and forearms.

Bone destruction occurs in the upper ends of the arms and lower part of the thigh bones. It may be seen in the form of spotted osteolytic layers or larger circumscribed areas of diminished density and thinning of the cortex.

Osteoatrophy or osteoporosis does not affect all bones or single bones as a whole. Some areas or some bones show a greater and others a lesser degree of rarefaction. This change is very likely to occur in chronic leukemia but is often hard to recognize in its initial stages.

It is the authors' conclusion that in patients with clinical leukemia it is useful to examine the whole skeleton systematically in a search for typical changes.

Fifteen roentgenograms; 1 table.

FRANK T. MORGAN, M.D.
Auburn, N. Y.

Discography: Technique, Indications and Evaluation of the Normal and Abnormal Intervertebral Disc. Ralph B. Cloward and Louis L. Buzaid. Am. J. Roentgenol. **68**: 552-564, October 1952.

A procedure for discography is presented, together with a description of the normal and abnormal intervertebral disk demonstrated by that method. The examination is performed only in the patient whose history strongly suggests a ruptured disk and whose myelogram appears normal.

Analgesics are administered one hour prior to the procedure. The patient is placed on the x-ray table with his spine flexed in the normal position for a lumbar puncture. Number 19 needles (1 1/2 inches) are inserted, full length, between L4-5 and L5-S1, and the accuracy of their position is checked by a lateral roentgenogram. A No. 22 or No. 24 spinal needle, 4 inches long, is inserted through the No. 19 needle and is pushed through the spinal canal into the annulus fibrosus, where

slight resistance is met. A "give" is felt as the nucleus pulposus is entered. Diodrast, 25 per cent, is forced into the nucleus through the fine needle. A normal disk will take 0.5 to 1 c.c., but pressure for thirty seconds to one minute must be exerted upon the syringe to allow diffusion of the medium. If a disk is damaged, 2 to 5 c.c. can be injected with ease. Following the injection, roentgenograms are obtained with the patient in both the supine and upright lateral positions. Diodrast is absorbed from the disk in twenty to sixty minutes, disappearing more rapidly from the normal than from the damaged disk.

Normally the opaque solution diffuses through the nucleus pulposus only. The nucleus may be oval, square, round, or of a "collar-button" shape. A radiolucent horizontal band extends through its center. The lateral view shows the anterior portion of the annulus fibrosus to be twice as deep as the posterior portion.

Rupture of a disk may occur anteriorly, posteriorly, posterolaterally, and/or vertically. Posterior herniation is the most common and is manifest on the discogram as an extension of the opaque material posteriorly. It may protrude into the spinal canal or dissect beneath the posterior longitudinal ligaments. Anterior herniation may be associated with tear of the anterior longitudinal ligament and collection of the Diodrast anterior to the disk.

The "degenerative disk," evidenced by narrowing of the intervertebral space and osteophyte formation on the routine roentgenogram, shows by discography a thin line of opaque material extending throughout the interspace and usually beyond.

Vertical herniations of long standing are indicated on the routine film by Schmorl nodules because of the marginal sclerosis. However, recent herniations which have not produced sclerosis may not be suspected until the defect is shown by discography.

The authors feel that the information obtained from this examination will lead to improvement in effective treatment of back pain.

Twenty-three roentgenograms; 2 photographs.

DORIS E. PIPKIN, M.D.
Louisville General Hospital

Tuberculosis of the Rib. Maurine P. Johnson and Emil Rothstein. J. Bone & Joint Surg. **34-A:** 878–882, October 1952.

This report is concerned with tuberculous osteitis of the rib presumably of hematogenous origin. This is a rare condition and is to be distinguished from a more common condition, tuberculosis of the costal cartilage, which may involve the bone secondarily. Reports of true tuberculous osteitis have been very infrequent in the literature. Three cases are presented here, proved by demonstration of tubercle bacilli in cultures of pus from the lesions. There was no evidence in any of the cases of extension to the bone from adjacent infection. The lesions were considered to be of hematogenous origin. In two of the cases the bone lesions were the only evidences of tuberculosis.

In each case the symptoms consisted of swelling produced by a cold abscess and mild toxic manifestations. Physical findings were those characteristic of cold abscess. One patient showed a small pleural effusion on the same side as the lesion. Roentgenographic findings consisted of destructive bone change: in 1 case, the area of diminished density occurred within the substance of the rib, while in the other 2 cases, the osteolytic changes involved the rib margin initially and the body of the rib later. The bone changes did not appear until several months after appearance of the abscess. Because of the delay in appearance of roentgenographic evidence of bone change, tuberculosis of the rib cannot early be ruled out as the cause of an otherwise idiopathic cold abscess.

The treatment recommended by the authors is incision and drainage of the abscess, with resection of the involved bone after a short interval. The two-stage procedure is considered preferable to the one-stage because, after incision and drainage, the pus diminishes and may become sterile. The chance of spread of infection during rib resection is then considered to be less. In addition, Streptomycin and para-aminosalicylic acid are recommended, starting a week or two before surgery and continuing until healing is complete.

Four roentgenograms.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Radiological Evidence of the Value of Treatment in Gout. F. G. W. Marson. Brit. J. Radiol. **25:** 539–541, October 1952.

Three cases of gout under treatment with salicylates showed recalcification in the cystic areas, roentgenographically. Such evidence of improvement has not previously been recorded.

Six roentgenograms; 1 graph.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Intraosseous Travel of a Missile. H. G. Drewes. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 451–455, October 1952. (In German)

A case is reported in which a missile lodged in bone during World War I migrated, over a period of thirty-seven years, from the lower third of the shaft of the femur through the condyles into the soft tissues of the knee joint. This report is supported by roentgenograms taken at long intervals and a tomograph which demonstrates the path of the missile through the bone. The author assumes that osteolysis around the foreign body due to the weight of the projectile may be the cause of the travel through bone (osteolysis due to pressure).

Six roentgenograms.

JULIUS HEYDEMANN, M.D.
Chicago, Ill.

GYNECOLOGY AND OBSTETRICS

Stress Incontinence of Urine. T. N. A. Jeffcoate and Henry Roberts. J. Obst. & Gynaec. Brit. Emp. **59:** 685–697, October 1952.

This paper is the second of two on stress incontinence of urine (the first by Albert Aldridge) and is largely devoted to the roentgen aspects of this condition. The authors' comments are based on the x-ray examination of the bladder and urethra of 132 non-pregnant women. The findings on cystourethrography of 24 women without prolapse or stress incontinence are described.

Significant anatomical changes were seen in the cystourethrograms in all but 2 of 67 women with stress incontinence, direct lateral views giving the most striking and constant findings. These were:

1. Loss of the normal posterior urethrovesical angle so that the base of the bladder and urethra are in line. This was a feature in 54 of the 67 cases in this group. In two-thirds of these it was present even with the patient at ease; in the others it only became apparent on straining.

2. Funneling of the urethrovesical junction. This is most often merely part of the picture associated with loss of the posterior angle and is, therefore, seen in lateral skiagrams. In only 4 cases was funneling of the internal meatus present without a coincident change in the urethrovesical angle. It is in these comparatively rare cases that anteroposterior exposures may reveal funneling better than lateral ones.

3. Increased downward movement of the bladder base and rotation of the urethra on straining, and particularly during micturition. This change, however, except in so far as it is related to loss of the posterior angle, is probably insignificant in that it appears to be related to the degree of prolapse present, rather than to the severity of the incontinence.

4. In 4 cases in which the shape of the urethrovesical junction was normal, there was a localized herniation of the trigone of the bladder.

5. In addition to loss of the posterior urethrovesical angle, leakage of bladder fluid into the urethra on straining was seen in 7 cases.

6. During micturition the appearances are essentially the same as in normal controls. Indeed, even though the bladder and urethra may be situated at a lower plane in the pelvis and may descend further during straining, the function of micturition is undisturbed in women who suffer stress incontinence.

In 23 women who suffered from prolapse without stress incontinence, the cystographic appearances were as follows:

1. Sagging of bladder base and urethra, often with descent to extreme limits on straining, present in all cases. These two structures move together, thus tending to preserve their normal relationships, one to the other.

2. Preservation of the posterior urethrovesical angle on straining in all but one case. In 2 others, however, the angle was not very pronounced.

3. No funneling of the internal meatuses save in one case.

4. During micturition the appearances are similar to those in normal women except for modification of the slope of the upper urethra by the prolapse.

The most significant anatomical deformity associated with stress incontinence is loss of the posterior urethrovesical angle. Restoration of this angle is a feature of successful operations for this complaint, correction of funneling of the internal meatus being of less importance. Various technics for supporting the bladder base and upper urethra during anterior colporrhaphy give relatively unsatisfactory results because they rarely correct the significant anatomical deformity. Indeed, anterior colporrhaphy sometimes makes it worse. The Aldridge fascial sling operation restores the posterior urethrovesical angle and uplifts the urethrovesical junction, but it does not insure continence by kinking the urethra during stress. The overall symptomatic results in a series of 29 Aldridge operations are presented.

Fifteen roentgenograms; 24 drawings.

This paper is followed by a discussion extending from page 697 to 720.

Observations on Stress Incontinence of Urine. T. N. A. Jeffcoate and Henry Roberts. Am. J. Obst. & Gynec. **64:** 721–738, October 1952.

The authors report studies carried out over a period of three years on nulliparous and multiparous women, and women suffering from prolapse either with or without stress incontinence. These involved more than 900 exposures of the bladder and urethra in 130 women, with particular attention to direct lateral cystography. The effects of two operative procedures, anterior colporrhaphy and the Aldridge sling operation, were studied, though it is not suggested that these are the only therapeutic measures to be practised. Further investigation of various other procedures is desirable so that the best methods may be determined.

Lateral roentgenograms of the bladder and urethral areas were taken with the bladder containing opaque material in three situations: (1) with the patient at ease, (2) during the act of straining, and (3) during micturition. Roentgenograms and excellent diagrams are presented for normal patients, patients with prolapse but without incontinence, and patients with stress incontinence with or without prolapse. The findings have been reported, in somewhat fuller detail, in the paper abstracted above.

Nine roentgenograms; 24 drawings; 2 graphs.

JOHN M. KOHL, M.D.
Jefferson Medical College

THE GENITOURINARY SYSTEM

Pyelography with Respiration: Its Diagnostic Value in Urology. B. Mangelsdorff. Fortschr. a. d. Geb. d. Röntgenstrahlen **77:** 434–444, October 1952. (In German)

The author describes his experience with pyelography without suspension of respiration and compares it with previously published reports. The movements of the normal kidney during respiration can be explained on the basis of the anatomy of the renal capsule. Of 176 cases routinely examined, 32 showed no kidney disease, and of this number 58 per cent showed greater movement on the left side than on the right. The average figures were: for men, 11.8. mm. on the right and 16.0 mm. on the left; for women 21.8 mm. on the right and 24.0 mm. on the left. In 22 additional normal cases there was no movement bilaterally.

The author discusses several pathological conditions. Paranephritic abscess shows absence of motion nearly constantly; ureteral and kidney calculi show no motion in 50 per cent of cases; hydronephrosis and pyelonephritis in 50 per cent of cases. Positive findings observed on pyelography during respiration are therefore to be considered only as a symptom and require clinical and roentgenologic evaluation.

Four tables.

JULIUS HEYDEMANN, M.D.
Chicago Ill.

Intrarenal Gas: Report of a Case and Review of the Literature. G. Ashby Winstead. J. Urol. **68:** 423–429, August 1952.

The author describes the case of a white female who complained of abdominal pain and vomiting. She had undergone a right vaginal ureterolithotomy following an attack of right renal colic twelve years previously. Urinalysis revealed many white cells and culture of the urine yielded *Proteus* and *Pyocyaneus*. A roentgenogram demonstrated intrarenal gas outlining a dilated

right renal pelvis and calyceal system. A ureteral catheter was introduced and 40 c.c. of air were aspirated from the kidney pelvis. The patient then underwent a right nephrectomy. The pathological diagnosis was hydronephrosis and chronic pyelonephritis. Cultures taken directly from the surgical specimen yielded *Pyocyaneus*.

The author includes a discussion of gas bacillus infections of the kidney and a review of published cases.

[The case described differs from previously reported cases of renal clostridial infections in several respects. The patient did not exhibit the profound toxicity of anaerobic infection. The intrarenal gas appears to have been confined to the pelvocalyceal collecting system and was not seen in the parenchyma of the kidney or in the perirenal structures. No gram-positive spore-forming bacilli were demonstrated either by stain or culture, or in histologic sections of the kidney.—A.K.]

Three roentgenograms; 1 table.

ADELE KYNETTE, M.D.
University of Pennsylvania

Retrocaval Ureter. Report of a Case and a Review of the Literature. Benjamin S. Abeshouse and Louis H. Tankin. Am. J. Surg. **84**: 383–393, October 1952.

The authors report what they believe is the fifty-eighth case of retrocaval ureter to be recorded.

A congenital anomaly of the vena cava and its tributaries is responsible for the abnormal course of the ureter, which is lateral to the vena cava in its upper third and at the level of the fourth lumbar vertebra passes behind the vena cava to encircle it partially and continue downward anterior to the vessel.

The diagnosis is made from characteristic roentgen findings with opaque catheters and ureteropyelograms in the anteroposterior, oblique, and stereoscopic positions, namely (1) a sickle-shaped or S-shaped curve of the ureter; (2) extension of the ureter upward and to the left to reach the mid-line of the fourth or fifth lumbar vertebra, from which it passes to the right, encircling a structure the size of the vena cava; (3) dilatation of the upper third or fourth of the ureter and pelvis and a normal caliber of the mid-portion and lower third.

Venography has not been employed in any case to date but may prove of value in establishing the anatomic relations of the anomalous ureter and venous systems and in determining the type of surgical treatment.

Asymptomatic cases of retrocaval ureter with no roentgen evidence of severe obstructive changes in the upper ureter and pelvis require no surgical treatment but should be studied roentgenographically at intervals of six to twelve months. Nephrectomy should be restricted to those cases presenting irreparable damage in the affected kidney. Conservative operations should be employed when the ureter and pelvis show a relatively minor degree of dilatation.

Two roentgenograms; 1 photograph.

Retrocaval Ureter: Case Report and a New Diagnostic Approach. Paul R. Leberman, Hans H. Zinsser, and D. Franklin Milam. J. Urol. **68**: 679–683, October 1952.

A white male of 23 years complaining of right flank pain underwent excretory urography, which demonstrated normal function of the left kidney but showed the right kidney to be involved in a large hydronephrosis and hydroureter in the upper segment, with a horseshoe-shaped deformity extending toward the spine. The lower segment of the ureter was not visualized. A retrograde pyelogram showed an S-shaped curve of the ureter, the mid-portion of which overlay vertebral bodies L-3, 4 and 5. A diagnosis of retrocaval ureter was confirmed at operation. The ureter was obliquely divided about 4 cm. below the ureteropelvic junction, the lower segment was removed from behind the vena cava, and anastomosis was accomplished.

The diagnosis of retrocaval ureter has heretofore depended primarily upon two pyelographic findings, namely, medial displacement of the right ureter over the vertebral column and an S-shaped curve, both of which were observed in the present case.

Since renal vein catheterization for determining renal clearance of various substances is now a relatively simple matter, it was thought that such a procedure might aid in the diagnosis of retrocaval ureter. Accordingly, the authors performed a series of cadaver experiments in which catheters were placed in the right ureter and the vena cava. In the normal relationship the ureteral catheter may be seen crossing the vena caval catheter only once, at the superior level of the sacrum. When an experimental retrocaval ureter was constructed in the cadaver it was seen that the ureteral catheter crossed the caval catheter at three levels.

Four roentgenograms.

ALFRED O. MILLER, M.D.
Louisville, Ky.

THE BLOOD VESSELS

The Present Status of Arteriography in Germany. H. W. Paessler. Angiology **3**: 345–354, October 1952.

In Europe, particularly in Germany, serial arteriography is today considered essential for the reliable recognition of vascular affections. The apparatus described by the author permits the taking of three roentgenograms at any required interval. Through a special *tubus* (drawtube), the exposure of the central and peripheral sections of a limb can be so balanced that all three roentgenograms can be made with the same exposure times.

Normally the medium is introduced by percutaneous puncture rather than surgical exposure. The injection of hyaluronidase affords protection against hematomas. Perabrodil M (Bayer) is used as the contrast agent, 60 per cent for arteriography and 80 per cent for aortography.

The contrast material is injected by means of a pressure apparatus, which ensures maximum concentration in the different sections of the vessels. Through the use of special cannulae, the danger of perivascular injection is almost completely precluded.

The intervals between the three roentgenograms are determined by oscillometric examinations, which are carried out with an oscillograph on both legs simultaneously, with automatic recording. These curves permit subsequent control to check the results of treatment.

Eight arteriograms; 4 photographs.

The Roentgenographic Differentiation of Peripheral Arteriosclerosis. Edwin N. Barnum. Am. J. Roentgenol. **68**: 619–626, October 1952.

An interesting review of the pathological changes of the two types of peripheral arteriosclerosis, intimal

(atherosclerosis) and medial (Mönckeberg's arteriosclerosis), is given, and these are correlated with the roentgen appearance.

Medial arteriosclerosis (Mönckeberg) consists in deposition of calcium in connective tissue of the medial coat of muscular arteries, particularly the femoral, popliteal, tibial, and radial. Roentgenographically, the calcifications appear as multiple concentric but incomplete rings or sheets of calcific density, producing a trachea-like appearance. The lumen of the vessel is not narrowed; consequently, clinical symptoms are absent.

Intimal atherosclerosis begins with lipoid deposition in the deeper aspect of the intima. The atheromata thus formed become surrounded by fibrous tissue, which hyalinizes and later calcifies. The calcifications are patchy, irregular plaques of variable size, which are more dense than the calcific deposits of medial sclerosis. There is associated narrowing of the vessel lumen, which results in the signs and symptoms of peripheral arterial occlusion. However, among patients with clinically evident peripheral atherosclerosis, 33 per cent of males and 69 per cent of females will not have calcium in the atheromatous lesions.

Both types of arteriosclerosis may exist in the same artery. When this occurs, the more dense calcific plaques of atherosclerosis may obscure medial calcifications.

Excellent examples of each type of arteriosclerosis, as well as the combined form, are presented in clinical roentgenograms, roentgenograms of the isolated vessel, and photomicrographs.

Eighteen roentgenograms; 7 photomicrographs.

DORIS E. PIPKIN, M.D.
Louisville General Hospital

A Roentgenologic Study of the Coronary Arteries in the Living. Lucio Di Guglielmo and Mariano Guttadauro. Acta radiol., Supp. 97, 1952.

The authors describe a technic of aortography which opacifies the coronary arteries in a high percentage of cases. A catheter (No. 9 or No. 10F) is introduced *via* the radial artery into the ascending aorta. Under fluoroscopic control the tip of the catheter is positioned in the middle or upper third of the ascending aorta. The lower third is not entered lest too much medium be introduced into the coronary vessels. Catheterization of the innominate artery is likewise avoided, since convulsions may occur if a large amount of the contrast medium reaches the brain. The procedure is free of complications when these two positions of the catheter tip are avoided. Umbradil 70 per cent (Astra) is injected through the catheter at a rate of 20 to 30 c.c. per second and in a dosage of 1.0 to 1.2 c.c. per kilogram of body weight. Films in two planes at right angles are taken simultaneously. Ten pairs of films are obtained within about seven seconds.

Observations were made on 235 patients. A total of 328 examinations were done including 159 aortograms and 169 angiocardiograms. Most of the patients were suffering from coarctation of the aorta, patent ductus arteriosus, or other congenital malformations of the heart. In 8 cases there was no disease of the coronary system. These normal coronary arteriograms were substantially the same as those in the majority of the larger series of cases.

With the aortographic method, coronary arteries were visible in 112 of 159 examinations. Failure of filling in 47 cases occurred because of insufficient concentration of medium in the aorta (due to low position of the catheter tip, slow injection, or existence of pathological conditions which interfered with filling). Carotid cannulation did not produce satisfactory results. Intravenous angiocardiography did not opacify the coronaries in any case. Selective angiocardiography filled the coronaries in 9 cases. In 6 of these the tip of the catheter was in the pulmonary conus, and in the remaining 3 cases, a large interventricular septal defect and the overriding aorta permitted injection of a large part of the contrast medium directly into the aorta.

Simultaneous coronary angiography and electrocardiography indicated (1) that in general aortic bulb and coronary artery filling and emptying occur at the same time, (2) that maximum arterial opacity occurs during ventricular diastole, and (3) that movements of the coronary arterial branches occur in the same direction as those of the corresponding sections of the heart to which they are distributed.

The right coronary artery was visualized in both the anteroposterior and lateral views on 90 occasions. The left coronary artery was visible on 100 occasions, being more readily demonstrated in the anteroposterior projection. In 90 cases the anterior interventricular branch of the left coronary artery could be seen in either the anteroposterior or the lateral projection. The circumflex branch was demonstrated 89 times in the anteroposterior film.

In view of the brief time that medium is in the coronary system (2.5 to 4 seconds) and the absence of significant ill effects from the examination, the authors believe that coronary arteriography could be employed diagnostically in coronary disease if proper technic and precautions were observed.

Forty-nine illustrations including 39 roentgenograms with tracings.

RICHARD F. MCCLURE, M.D.
Palos Verdes Estates, Calif.

Intra-Abdominal Venography Following Inferior Vena Cava Ligation. Cyril T. Surington and August F. Jonas, Jr. Arch. Surg. **65**: 605–609, October 1952.

The authors describe their technic of venography to demonstrate the collaterals after ligation of the inferior vena cava. They introduce a polyethylene catheter of 1.19 to 2.15 mm. internal diameter into the greater saphenous vein and through it inject 50 c.c. of Neoiopax or Diodrast. Roentgenograms are then taken, with a Bucky diaphragm beneath the patient.

The principal collaterals demonstrated are: (1) ascending lumbar veins communicating with the azygos and hemiazygos in the thorax, (2) vertebral veins, (3) ovarian veins, (4) ureteral veins, and (5) superficial trunk veins, which are the least important.

The authors conclude the collaterals are immediately open in normal subjects and that little disability will follow ligation unless there has been pre-existing vascular disease or recurrence and extension of the same.

Three roentgenograms; 1 drawing.

PAUL MASSIK, M.D.
Quincy, Mass.

THE SOFT TISSUES

Ultrasonic Visualization of Soft Tissue Structures of the Body. Douglass H. Howry and W. Roderic Bliss. J. Lab. & Clin. Med. **40**: 579–592, October 1952.

The authors suggest the use of ultrasonic energy to

obtain echoes from tissue interfaces which may be made to generate a cross-section "picture" of the part studied. They have themselves devised an instrument of this type which they call a "somascope" for making soft-tissue structures visible for diagnostic purposes. With technical improvements and further clinical studies, they believe this should prove a useful adjunct to roentgenologic study.

Seven illustrations.

FILM STORAGE

The Problem of a Roentgen Archive. Milan Svoboda. Acta radiol. et cancerol. bohemoslov. **6**: 59–63, 1952. (In Czechoslovakian).

By a recent order of the Czechoslovakian Health Ministry x-ray reports and films have to be preserved for a period of ten years. The author points out the difficulties of providing the necessary space for such x-ray archives. In his own department at Prague-Bulovka there would have to be provision for about 250,000 films, in a neighboring archive (Prague 7) for another 150,000 films. In one year the weight of the films at Bulovka would amount to about 500 kg., at Prague 7 to another 300 kilograms. In order to reduce the immense bulk of such material, it is recommended that microphotographic reproductions be kept instead of the original films. The author recommends a uniform registration system based on combination numbers derived from the patient's birth date.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

RADIOTHERAPY

Hemangiomas: Treatment and Repair of Defects. Report of Minimal Radiation Dosage and of Multiple Suture Procedure. James Barrett Brown and Minot P. Fryer. Surg., Gynec. & Obst. **95**: 33–44, July 1952.

Arterial hemangioma occurs frequently, and prompt treatment is necessary to save tissue, features, and often the life of the patient. This is probably the only type of hemangioma that is truly neoplastic, the others being more in the nature of congenital anomalies. Growth is very rapid, and many times features are destroyed before treatment is sought. A policy of expectancy is futile, for these tumors will never "cure themselves."

Arterial hemangiomas may occur anywhere in the skin or mucous membrane; their position and size are of prime importance in the choice of treatment. The diagnosis can be made clinically as well as microscopically. There is a soft compressible red spot which may be raised from the skin, with firm tumor beneath or in the surrounding skin. The fact that the tumor is bright red indicates its arterial nature.

Ideal treatment is control of the tumor without injury to the growth or development of the surrounding parts and with a minimum of scarring. Each case must be evaluated individually. Where the scar is of no practical importance and the lesion is small, a platinum electrocautery can be used. Many lesions have been treated successfully by thermal coagulation. Surgical excision and closure by suture is the method of choice when there is sufficient tissue to permit this without distortion of features. Treatment by irradiation, burning, injections, or freezing may produce so much residual scarring that further treatment by surgery may be necessary for satisfactory function and appearance. Irradiation may be limited in its application if the lesion lies deep or in an area adjacent to vital structures.

Interstitial irradiation in minimal dosage is often indicated for treating arterial hemangiomas. Gold radon seeds can be placed accurately in the tumor itself, and the overlying skin can be spared. Minimal dosage and accurate placement make for protection of underlying structures, a fact that this article emphasizes. The authors feel that the minimum dose to be employed is considerably smaller than any heretofore reported. Gold radon seeds of 0.1 mc. are most often used, this amount controlling about 1 c.c. of arterial hemangioma with the least chance of irradiating the surrounding tissues. This low dosage has greatly minimized the necessity of secondary reconstruction. Heavier doses have resulted in deformity by interference with skeletal growth and often have produced distortions impossible of correction. Even with low dosage, some radiation lesions may occur, and subsequent resection and repair may be required.

Port-wine stains are more or less radioresistant and are best treated by surgical excision and grafting. These lesions are not tumors and they do not destroy features. Radiation has been used, but a great amount is needed, and the end-result may be a radiation dermatitis, substituting one skin defect for another. Pigment tatooing is no longer considered a satisfactory form of treatment.

Cavernous angiomas consist of veins and venous blood-filled spaces. They may occur anywhere and may reach considerable size. The usual treatment is surgical excision and repair or, when indicated, preliminary irradiation or injection with a sclerosing material. Irradiation will have an effect only on the small vessel component of the tumor. Multiple suture obliteration of cavernous angioma is often indicated where large areas are involved and the treatment may be given in stages.

Spider angioma can be treated by cautery; if this is not effective, resection and repair are indicated. These tumors are not radiosensitive.

Lymphangiomas and hygromas are best treated surgically, but if the lesions are growing rapidly, heavy irradiation may be indicated for their control prior to resection and grafting.

The authors point out that the clinical picture is often more important than the microscopic in evaluating treatment, *e.g.*, in the case of huge tumors involving head and neck, there may be no cure histologically speaking, but a combination of treatment may give the patient function and life.

Seventeen figures (excellent legends).

LOIS I. KING, M.D.
University of Pennsylvania

Fourteen Years After Radium Therapy of an Extensive, Destructive Ulcerating Angioma of the Face. Ira I. Kaplan. Arch. Pediat. **69**: 393–396, October 1952.

A case is presented indicating that radium therapy for angioma may be not only a life-saving measure but an excellent cosmetic procedure for controlling a destructive lesion. Fourteen years after treatment of an

extensive angioma in a child of four months the lesion remained completely healed, with an inconspicuous scar. No untoward effects of the radiation had developed.

Two photographs.

X-Ray Treatment of Skin Tumors at the University Clinic, Ziegelstrasse, Berlin, 1935–49. Wilhelm Greve. Strahlentherapie **89**: 401–408, 1952.

This is a report on 644 primary skin tumors treated by irradiation between 1935 and 1949. The number of symptom-free patients at the end of that period is given as 91 per cent. Of interest is a note on the radiation therapy of melanomas, which has been used in many cases since 1930 as the primary method of treatment. Of 22 patients with melanoma treated primarily by irradiation, 21 (95 per cent) became symptom-free and only 1 (5 per cent) died. The dose was 10,000 to 12,000 r. In contrast, of 22 patients treated primarily by extirpation, with postoperative x-ray therapy, only 7 (31.5 per cent) became symptom-free; 14 (64 per cent) died from generalized metastases and 1 (5 per cent) was lost to follow-up.

Six illustrations; 4 tables.

ULRICH K. HENSCHKE, M.D.
Columbus, Ohio

Our Experiences with the Reticulo-Sarcoma. Jan Kotas. Acta radiol. et cancerol. bohemoslov. **6**: 1–8, 1952. (In English).

Numerous difficulties are encountered in attempting to diagnose and classify reticulosarcoma. The histologic evaluation is difficult because of the varying stages of maturity and because of the similarity of some forms to carcinoma of different origins. Even with repeated biopsy of the tumor or of involved lymph nodes a definite diagnosis may not be apparent.

In the author's analysis of 79 cases seen at Masaryk State Institute for Radium Therapy from 1940 to 1949, such sites were involved as lungs, stomach, maxillary sinus, epiglottis, tonsils, and fibula.

All of the patients received radiation therapy as soon as possible after biopsy. In the majority of cases external irradiation was used, but in some cases, such as those involving the nasal cavity, this was combined with radium therapy.

The method used was to cross-fire the part through opposing ports of 10 × 15 cm. The area was treated at first once a day and later twice a day for about five or six weeks. The protracted fractional method was used, especially in young patients, to avoid later skin changes. After surgical removal of solitary lymph nodes showing reticulosarcoma, however, the authors employed massive radiation, usually about 600 r, repeated three times after longer intervals. It is felt to be a mistake to discontinue therapy as soon as the tumor or lymph nodes disappear. For therapy to be complete a tumor dose of 4,000 to 4,500 r must be obtained. Relapse is to be expected after a short time if this is not done. If the process is generalized, fractional or massive doses may be given, but these efforts had only a palliative effect.

The prognosis was found to depend on the position of the tumor, age of the patient, and state of maturity of the tumor. Even though very sensitive to irradiation, the mixed forms have a tendency to become generalized. Best results were obtained with localized solitary tumors.

Ten roentgenograms. FRANK T. MORAN, M.D.
Auburn, N.Y.

Rotational Scanning of Breast Malignancies with Supervoltage Radiation. Hugh F. Hare, John G. Trump, and Edward W. Webster. Am. J. Roentgenol. **68**: 435–447, September 1952.

A scanning method of rotation therapy with a 2-mev x-ray apparatus used in 10 cases of Stage III (Portmann) cancer of the breast is presented. The patient is rotated about an axis coinciding with the center of a circle that circumscribes the lung on the involved side. The beam is directed to an off-center rectangular portal, irradiating the treatment area tangentially as the patient is rotated. The result is that a zone of tissue extending from the axilla to the mediastinum and bounded by the pleura on the inside and the subcutaneous tissues on the outside is irradiated. Inequalities in field contours are diminished by means of compensating and wedge-step filters, so that a fairly homogeneous dose is delivered to the desired volume. Supplementary fields may be used to obtain further homogeneity. An attempt is made to deliver a 6,000 r tumor dose in forty days.

Nine of the 10 patients treated have been followed for from five to fifteen months with one recurrence.

The original article should be consulted for technical details.

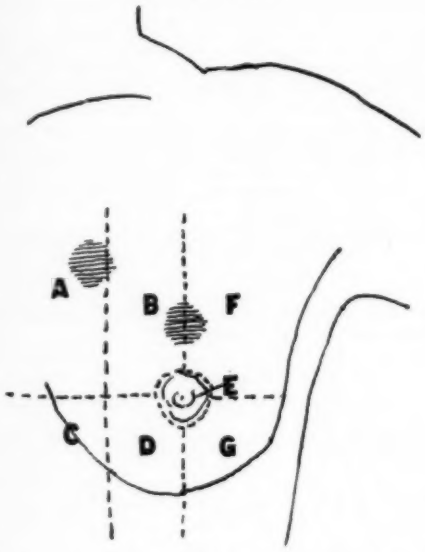
Nine illustrations. A. R. BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

Radical Mastectomy in Continuity with en Bloc Resection of the Internal Mammary Lymph-Node Chain. A New Procedure for Primary Operable Cancer of the Breast. Jerome A. Urban, with a Statistical Study by Harvey W. Baker. Cancer **5**: 992–1008, September 1952.

In a series of 100 primary operable breast cancers in which the internal mammary nodes were biopsied during radical mastectomy, R. S. Handley found metastatic nodes in the internal mammary chain in approximately 60 per cent of medial half lesions, and in about 20 per cent of the outer half lesions. His work has reemphasized the fact that the lymphatic drainage of the breast extends into two main primary depots: the axillary lymph nodes and the internal mammary lymph-node chain. Surgeons and radiotherapists have been paying increasing attention to the problem of methods of treatment of the internal mammary lymph-node chain in patients with carcinoma of the breast. In this paper the author presents statistics on 40 patients who have undergone a radical mastectomy with *en bloc* resection of the internal mammary lymph-node chain. A detailed description of the operative technic is presented. In the 40 patients the author reports that he has had no mortality and actually very little increase in postoperative morbidity with this operation as compared with the usual radical mastectomy.

Thirty-eight of the 40 patients operated on had the primary lesion in the medial quadrant of the breast. Twenty of these patients exhibited internal mammary lymph-node metastasis. Of the 2 upper outer quadrant lesions included in the series, one presented metastatic deposits in each of the primary lymph drainage areas. In the accompanying figure a listing of the lesions is

METASTATIC INVOLVEMENT OF AXILLARY AND INTERNAL MAMMARY NODES IN PRIMARY OPERABLE BREAST CANCER FOR VARIOUS SECTORS



Lesions contiguous with the vertical lines are assigned to the sector lying on the sternal side of that line; those overlying the horizontal lines are assigned to the lower sector. Lesions lying behind the areola and nipple belong in sector E.

Location →	A	B	C	D	E	F	Inner Half	Total
Total no.	6	22	3	3	4	2	38 (100%)	40 (100%)
All nodes free	1	9	0	1	0	1	11 (29%)	12 (30%)
Internal mammary only invaded	1	0	0	1	0	0	2 (5%)	2 (5%)
Axillary only invaded	0	4	2	1	0	0	7 (18.5%)	7 (17.5%)
Both internal mammary and axillary invaded	4	9	1	0	4	1	18 (47.5%)	19 (47.5%)

Overall group: 40 cases
- 52.5% Positive internal mamary nodes
- 65.0% Positive axillary nodes
- 30.0% All nodes clear

In the 40 cases treated by radical mastectomy in continuity with *en bloc* resection of the internal mammary lymph-node chain, sectors A and E show a relatively high incidence of internal mammary lymph-node metastases—paralleling the poor results of routine radical mastectomy for lesions in these same sectors.

presented according to the location of the primary site in the breast.

While the postoperative follow-up period is too short to make any definite statements as to improvement in survival following this operation, the author believes that poor results of radical mastectomy in primary operable breast cancer when the primary tumor presents in the medial half of the breast are largely due to early involvement of the internal mammary lymph-node chain. He feels that radical mastectomy in continuity with *en bloc* resection of the internal mammary lymph-node chain should remedy this particular defect in the classical radical mastectomy operation.

Forty photographs and drawings; 5 tables.

D. S. CHILDS, JR., M.D.
Rochester, Minn.

An Expanding Fixed Tandem-Ovoids Colpostat for the Treatment of Carcinoma of the Cervix. Michel Ter-Pogossian, Alfred I. Sherman, and A. Norman Arneson. Am. J. Obst. & Gynec. **64**: 937–941, October 1952.

The authors describe a radium applicator of stainless steel supporting two expandable vaginal sources or ovoids and a fixed uterine tandem. The ovoids, made of Duralumin, are approximately cylindrical in shape, with a diameter of 2 cm. and a height of 2.8 cm. In the closed position the separation between the vaginal radium sources is 1.7 cm. This separation can be expanded to 5.2 cm. by means of a screw mechanism. The tandem is a Graflex plastic tube. The slight pliability of this tube allows easy introduction even into uteri acutely flexed. However, the tandem tends to regain its original shape and will in many instances straighten the uterus. Slight curvatures of the tandem will not significantly alter the isodose curves. In the great majority of cases a tandem 6 cm. long which accommodates three uterine sources is used. For small uteri, shorter tandems which contain one or two sources are employed. Where the cervix is inaccessible or too short to accommodate a single source, the vaginal portion of the colpostat alone is used.

The overall length of the colpostat is 11.2 cm. and it weighs 65 gm. The ovoids swivel freely around the axis of the vaginal sources allowing better positioning in accordance with the anatomical structure of the fornices.

A removable handle 16 cm. in length is fastened to the applicator for loading and for introduction into the vagina. The colpostat is easy to load with radium. The only equipment required is a pair of forceps and a screwdriver. The applicator is introduced into the vagina in the closed position. In this position the width of the instrument is 3.6 cm. Once the instrument is in place, the ovoids are expanded by turning the knurled knob at the end of the handle. When the desired width is reached, the vagina is adequately packed with gauze behind the ovoids. Then the handle is unlocked from the colpostat and withdrawn. An x-ray film is taken to verify the position of the colpostat in the pelvis and to determine the spread of the ovoids. These latter data are easily deduced from the film by determining the magnification factor from the apparent length of the radium cells contained in the tandem. The doses delivered to various strategic points are obtained from these data by direct readings from a table given in the text.

The colpostat described affords easy application and its removal from the patient is a simple maneuver, which can usually be accomplished without anesthesia. This colpostat may be applied in any vaginal vault over a range of 3.6 to 7 cm. in diameter. It has been found to maintain its position in the vagina over many hours with no discomfort to the patient. Because of the fixed

relationship of the ovoids to the tandem the cervix always maintains a predetermined ideal geometrical position.

Two roentgenograms; 3 photographs; 1 drawing; 1 table.

JOHN M. KOHL, M.D.
Jefferson Medical College

Segmental Resection and Radium Implantation in the Treatment of Carcinoma of the Urinary Bladder. Morton M. Kligerman, John N. Robinson, George W. Fish, and Isabel David. J. Urol. **68**: 706–713, October 1952.

From 1925 through 1949, 347 cases of carcinoma of the bladder were treated at the Presbyterian Hospital (New York) by segmental resection or radium implantation. One hundred ninety-eight were treated by radium and 149 by segmental resection.

The decision to do a segmental resection or implant radium needles was based on the size, the location, the number of tumors present, and the invasiveness of the tumor as far as could be determined by the appearance and palpation at the time of operation. Since the microscopic pattern varies greatly in a single lesion, biopsy was of little value in planning treatment.

The majority (80 per cent) of bladder tumors arise in the region of the trigone. Solitary, pedunculated lesions are controlled most readily. Sessile and submucosal nodular lesions tend toward invasiveness, making eradication more difficult. Extensive lesions of the bladder offer mechanical difficulties to treatment and only those confined to a resectable area or within reach of radium needles are amenable to either method of treatment.

The authors divide their cases into a "palliative" group, including all lesions greater than 25 sq. cm. and all lesions which had penetrated through the bladder wall, and a "definitive" group comprising cases in which the tumor had invaded the wall of the bladder but had not penetrated it. Lesions which involved the internal meatus but which did not reach down the urethra proper were deemed definitive for radium treatment. Lesions extending into the ureter were considered surgically definitive only when the entire neoplasm was resectable.

In the group treated by segmental resection, 46 cases were classed as palliative and 103 as definitive. Nine of the operable cases were admitted after 1946, making them ineligible for five-year evaluation, leaving 94 cases subject to analysis. In the group treated by radium implantation, 91 cases were classed as palliative, 107 as definitive. Of the latter, 44 were treated after 1946, leaving 63 cases to be evaluated on the basis of a five-year survey.

The five-year clinical arrest rate (absolute) was 22.3 per cent following segmental resection and 38.1 per cent following radium implantation. Statistical analysis reveals that the higher percentage of five-year arrests in the case of radium implantation differs significantly from the figure for segmental resection, and this despite the fact that the radium-treated cases were frequently more invasive and more inaccessible. It would appear, therefore, that patients in whom either segmental resection or radium implantation is possible would be better treated initially by radium implantation. This applies, with certain obvious exceptions, to all lesions under 25 sq. cm. which are of the sessile or submucosal nodular type, and to lesions which biopsy reveals to be of Grade 2, 3, or 4, especially if the excised specimen removed at operation reveals muscle invasion. In cases in which a tumor occurs in the vertex of a bladder whose wall is extremely thin, radium implantation can be technically difficult. Also, if there are multiple widely scattered polypoid lesions, implantation may not be technically practical. Here fulguration or excision seems to be the treatment of choice. Lastly, radium should not be used in adenocarcinoma of the urachus. In these cases wide segmental resection of the vertex and dissection of the atrophic urachus is the proper procedure.

The authors consider the cumulative survival rate by years a better expression of ability to arrest cancer than the five-year survival rate. When their cases are evaluated on this basis, it is apparent that treatment appreciably prolongs life.

Two graphs; 3 tables.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Intracavitary Irradiation of Lymphoid Tissue in the Nasopharynx. I. Dosimetric Problems. Josef Klumpar. Acta radiol. et cancerol. bohemoslov. **6**: 64–73, 1952. **II. Clinical Aspects.** Vlasta Hlasivcová and Zdeněk Hlasivec. Ibid., pp. 74–87. (In Czechoslovakian)

In the first part of this article Klumpar discusses the dosimetric problems relating to the intracavitary application of radium in the nasopharynx. Different types of applicators are described, and a guide to correct dosage calculation for beta radiators is given. In view of possible harmful doses to the torus tubarius (eustachian cushion) and septum, gamma radiators seem to be more advantageous than beta radiators. Theoretically, an applicator is recommended with the following optimal dimensions: lumen 4 mm., inner length 15 mm., wall thickness 0.5 mm. platinum, radium content 70 mg.

Hlasivcová and Hlasivec report results obtained in the Otolaryngological Clinic of the Charles University at Prague. Of 22 patients treated within two years, 11 were completely cured; in 4 patients partial improvement was noted; 2 patients remained unchanged, and 5 patients could not be followed. Radiation was given simultaneously over both eustachian tubes. A total of three treatments at intervals of two to three weeks was employed. With regard to indications and contraindications of radiation therapy, the authors followed the suggestions of Morrison (Arch. Otolaryng. **50**: 300, 1949).

Twelve illustrations; 2 tables.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Studies in Optimum Dosage. The Mackenzie Davidson Memorial Lecture. Ralston Paterson. Brit. J. Radiol. **25**: 505–516, October 1952.

While much progress has been made in the mechanical aspects of radiation therapy, the question of an optimum dose is still largely empirical. The term dose is used with a general meaning, embracing volume, time, and quantity of radiation.

The volume to be treated clearly affects the maximum possible safe dose. Studies of Stage I and II oral cancers treated by radium show clearly that when a relatively small volume is treated, even at the risk of missing small peripheral nests of cancer, the five-year survivals are definitely increased. This relationship is not so clear in bladder cancer treated with beam-

directed x-rays because the larger volumes used obviously indicate much larger tumors. In general the problem of x-ray therapy is more complex, because with small volumes the tolerance is governed by local normal tissue response, while with larger volumes constitutional responses become paramount.

Studies of mouth cancer show that there is a very much better response if the radiation is given in from three to five weeks than if given in from one to eight days. There is insufficient data to indicate an optimum time between three and six weeks. There is some evidence that in certain conditions like skin cancer a single dose (*i.e.*, short treatment time) is to be preferred.

The question of the quantity of radiation is hard to assess. In careful studies of cancer of the cervix there is indication that there may be a fairly critical point around 7,000 r radium plus 3,000 r x-ray.

No conclusions are drawn except that these questions are of sufficient importance to deserve intensive and carefully controlled study.

Five graphs; 21 tables. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

The 31-mev Betatron in the Radiotherapeutic Clinic of the Kantonsspital, Zürich. R. Wideröe and H. R. Schinz. Strahlentherapie **89:** 321–336, 1952. (In German)

An interesting modification of the betatron is used at the radiotherapeutic clinic in Zürich. By hitting the target from both sides with two electron beams alternately, two x-ray beams are produced, which can be used independently for treatment of two patients. In practice, the betatron is located in a small room between two therapy rooms. This arrangement has proved very satisfactory during two years of continuous use. The depth-dose curves are essentially the same as those published in the American literature.

An earlier report of experimental studies with this betatron was made by Epprecht (Strahlentherapie **89:** 161–174, 1952).

Fourteen illustrations.
ULRICH K. HENSCHKE, M.D.
Columbus, Ohio.

Depth Dose Data, 150 kVp to 400 kVp. H. E. Johns, S. O. Fedoruk, R. O. Kornelsen, E. R. Epp, and E. K. Darby. Brit. J. Radiol. **25:** 542–549, October 1952.

Dose measurements are presented for various field sizes from 0 to 400 sq. cm., focal-skin distances from 40 to 100 cm., half-value layers of 0.5 to 5.0 mm. Cu, and depths of 0 to 20 cm. These were obtained in a water phantom with a small ionization chamber connected to an automatic recording system. The results are said to be reproducible to within 5 per cent. For the actual data, the original paper must be consulted, as they are not readily abstracted. They will reappear in the Fifth Supplement to the *British Journal of Radiology*.

Eleven illustrations; 3 tables.
SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Secondary Radiation From Copper Filters in X-Ray Therapy. E. Zieler. Strahlentherapie **89:** 288–291, 1952. (In German)

Measurements of the secondary radiation of copper filters of deep therapy machines show that with the use of cones with plastic bases the secondary radiation of copper does not reach the skin. Since a 1.0-mm. aluminum filter absorbs about 6 per cent of radiation of 1.1 mm. Cu h.v.l., the author recommends ommission of such a filter, when cones with plastic bases are used.

One illustration. ULRICH H. HENSCHKE, M.D.
Ohio State University

Prognostic Importance of Changes in the Papanicolaou Smear After Radium and X-Ray Treatment. Gerhard Besserer and Horst Smolka. Strahlentherapie **89:** 442–455, 1952. (In German)

In contrast to the reports of Graham (Surg., Gynec. & Obst. **84:** 153, 166, 1947. Abst. in Radiology **50:** 141, 1948) and other authors, Besserer and Smolka found in a two-year study of 64 patients treated with radiation that serial Papanicolaou smears do not permit prognostic predictions in carcinoma of the cervix.

Eight photomicrographs.
ULRICH K. HENSCHKE, M.D.
Columbus, Ohio

RADIOISOTOPES

Diagnostic Use of Radioactive Isotopes. Lawrence Reynolds, K. E. Corrigan, and H. S. Hayden. Am. J. Roentgenol. **68:** 421–433, September 1952.

The diagnostic use of radioactive iodine in thyroid disease in 1,067 tracer studies in 817 patients over a four-year period is discussed. Counting was done with a well shielded hand-held probe, which is more flexible and accurate for small-dose tracer studies than is the fixed-distance counter. In addition to mapping counts over the neck, sternum, and other portions of the body over set time intervals, urinary excretion counts were made and urinary excretion curves plotted. An attempt was made in each case to account for 100 per cent of the administered tracer by recording the amount present in the thyroid, the residual amount in the patient's body and general circulation, and the amount excreted.

Several cases are reported, each one representing a statistically significant number of patients, to illustrate the value of the tracer technic. Two cases demonstrate differentiation between substernal masses of thyroid and non-thyroid origin. One case illustrates the discovery of a concealed toxic adenomatous recurrence in a previously thyroidectomized patient. An example is presented of a patient who had been labeled "psychoneurotic," but was shown to have a mass of thyroid origin impinging on both the trachea and esophagus, that could not be demonstrated roentgenographically. A final case is given to show a unique use of radioiodine-tagged fat in excluding a connection between the small intestine and a pancreatic fistula.

Trained clinicians can diagnose well over 90 per cent of all thyroid disease without special laboratory aid. The great field for the isotope tracer, aside from cancer, is in those cases which present mixed symptoms or, presenting serious symptoms, show nothing on standard clinical and roentgenologic examination. The authors emphasize the fact that the tracer technic belongs in a well controlled department of radiology. Unfortunately, radiologists have sometimes allowed it to pass to other departments, where it cannot be appreciated or properly used.

Nineteen illustrations, including 4 roentgenograms.
A. R. BENNETT, M.D.
Mt. Sinai Hospital of Cleveland

Radioactive Iodine in the Treatment of Hyperthyroidism. E. Perry McCullagh. Ann. Int. Med. **37**: 739–744, October 1952.

Of the twelve isotopes of iodine known, only I^{131} is now used in thyroid disease. It finds particular usefulness in Graves' disease. In multinodular goiter, surgery is usually the treatment of choice, though I^{131} may be used if for any reason operation is unacceptable.

It is important to make clear differentiation between the hyperthyroidism of nodular goiter and that of Graves' disease, for these two types differ in several important respects in their response to the isotope: (1) the dose required for control is larger in the nodular goiter, (2) the rate of improvement is slower, and (3) larger doses may be given with impunity, for post-treatment myxedema is not observed in this condition.

The author's experience with I^{131} treatment of nodular goiter covers 102 patients. The dose requirements for control varied widely. Three patients required only 7 mc., while the upper limits were 90 and 95 mc. in 2 cases. The average for the whole group was 34 mc., compared to 12 mc. for Graves' disease.

The most evident indication for I^{131} therapy in Graves' disease is in recurrent hyperthyroidism after surgery. It is also clearly indicated in cardiac cripples, the aged, and in recurrence after antithyroid drugs. The methods of calculation of dosage are currently based on the weight of the gland, as established roughly by palpation of the neck, and the percentage uptake of I^{131}. The prescribed dose usually lies between 100 and 200 microcuries per gram of thyroid. To avoid unnecessary hypothyroidism, the author uses two-thirds of any average curative dose. Control of 75 per cent of the cases has been achieved by one dose, 15 per cent by two doses, and 10 per cent by three or more doses.

If the patient has been pretreated with iodine in any form, and the uptake is low, treatment with I^{131} is postponed and propyl or methyl thiouracil or mercaptoimidazole may be given for a month to maintain control; two or three days after withdrawal of the antithyroid drug, I^{131} can be given.

The author has treated 642 patients with Graves' disease, with consistently excellent results. The only complication other than hypothyroidism was a near-crisis, requiring concentrated treatment, in a patient who had received a 25 mc. dose. Recurrences have been observed in about 2 per cent of the patients in whom the basal metabolic rate has reached normal and later risen to hyperthyroid levels.

The advantages of I^{131} treatment of Graves' disease are listed as follows: (1) no deaths; (2) no vocal cord paralysis; (3) no chronic tetany; (4) almost 100 per cent complete control; (5) thyroid size reduced, usually to normal; (6) no discomfort; (7) no time loss; no loss of income; (8) no hospitalization; (9) hyperthyroidism no more frequent than after surgery; (10) fewer recurrences than in other forms of treatment; (11) recurrences easily and successfully treated by I^{131}; (12) cheapest form of treatment.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Therapeutic Effects from Repeated Diagnostic Doses of I^{131} in Adult and Juvenile Hyperthyroidism. Sidney C. Werner, Howard Hamilton, and Martha R. Nemeth. J. Clin. Endocrinol. & Metab. **12**: 1349–1355, October 1952.

It is generally assumed that tracer amounts of radioiodine, I^{131}, have in themselves no physiologic effect. A number of observations would seem, however, to render this assumption questionable. Some patients are unusually sensitive to radiation effect from therapeutic doses; others with hyperthyroidism feel better after a single diagnostic tracer, and still others show a remission from thyrotoxicosis after administration of some drug where it is strongly suggested that the benefit is actually due to the tracer.

Twenty-nine hyperthyroid patients (2 men, 21 women, and 6 children) received repeated diagnostic doses of I^{131} and no other therapy. They were treated according to two dosage schedules, receiving carrier-free I^{131}, 40 microcuries weekly for five or six doses or 100 to 200 microcuries weekly for three doses. In some cases doses were repeated after several weeks.

In 8 patients complete remission of the hyperthyroidism was obtained, in 3 partial recovery, and in 18 no improvement. Four of the 6 children showed complete remission. The minimum dosage producing this result was 200 to 240 microcuries, which provided approximately 27 to 100 rep to the thyroid per 40-microcurie dose, and a total radiation of about 161–607 rep. In some patients who did not show clinical remission there were significant changes in the basal metabolism rate, serum precipitable iodine level, or thyroid uptake of I^{131}.

With 2 exceptions, remissions did not last more than three months. Nevertheless, the authors feel that the results show a definite therapeutic effect from the diagnostic doses. Spontaneous remissions in hyperthyroidism are seen in an estimated 1 in 25 patients, and are generally long sustained. Remission occurred in 1 in 4 patients in the present series, indicating that these were not spontaneous. Conclusions from investigations of hyperthyroidism consequently need reappraisal in the light of these findings to rule out the effect provided by diagnostic tracer procedures.

In children, the hyperthyroid gland appears especially sensitive to low levels of radiation, and the therapeutic possibilities of external irradiation are suggested.

Four tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Pathologic Effects of I^{131} on the Normal Thyroid Gland of Man. A. Stone Freedberg, George S. Kurland, and Herrman L. Blumgart. J. Clin. Endocrinol. & Metab. **12**: 1315–1348, October 1952.

The histologic effects of I^{131} irradiation have been studied in the thyroid glands of experimental animals, and a small number of biopsy specimens have been obtained in thyrotoxic patients after treatment with the isotope. The need for documentation of the tissue changes in the normal human thyroid gland after I^{131} administration, however, exists and prompted the authors to present this report. They have examined the thyroid gland and other tissues in 16 euthyroid patients treated for intractable angina and congestive heart failure who died at varying intervals after I^{131} treatment, and present a correlation of observed pathologic effects with amount of delivered radiation.

Rather complete case résumés are presented for all 16 patients. Death occurred from seven to one thousand and sixty-nine days after oral administration of from 17 to 157 mc. of I^{131}. Two patients who died seven days after isotope administration received approximately 14,500 and 31,000 rep (roentgens equivalent physical) to the thyroid gland and showed no histologic changes attributable to I^{131}.

Fourteen and twenty-four days, respectively, after administration of 59 and 26 mc. of I^{131} there was marked central destruction of the gland. Edema and degeneration of the stroma, acute vasculitis with thrombosis and hemorrhage, epithelial swelling and vacuolization, follicular destruction, and polymorphonuclear infiltration were noted.

In patients who survived for a longer period there were increased fibrous stroma, lymphocytic infiltration, thickening and hyalinization of the arteriolar intima. Follicular epithelium was desquamated and mixed with fragmented or globular colloid. Some atypical cells with large hyperchromatic nuclei were seen. In those patients who survived the longest (316 to 1,069 days), the thyroid gland was largely replaced by dense fibrous tissue. Myxedema was noted clinically. Continued degeneration of thyroid follicular epithelium was present long after administration of I^{131} and is felt to be related to progressive vascular damage and increasing fibrosis.

In one of the parathyroid glands which were examined, there were swelling and vacuolization of oxyphil cells in a fragment which was imbedded within the thyroid. There was no evidence of injury to the trachea, larynx, or adrenals. No evidence of pituitary abnormality attributable to I^{131} could be found, whereas chromophobe tumors have been reported in 90 per cent of mice eight months after administration of the isotope. No thyroid tumors resulting from treatment could be established.

Twelve photomicrographs; 1 table.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Influence of Iodine on the Release of Thyroid Hormone in Thyrotoxicosis. G. Ansell and H. Miller. Lancet **2**: 5–10, July 5, 1952.

Tracer experiments with radioactive iodine (I^{131}) were made in duplicate on three groups of thyrotoxic patients. One group was given no drugs and was used as a check on the reproducibility of the results. A second group was given methylthiouracil, and the third group sodium iodide, during the second tracer experiment. The drugs were administered in each case after the peak uptake of the radioiodine in the gland had been passed.

The rate of fall of the gland radioactivity was much increased by the administration of methylthiouracil but was unaffected by sodium iodide. At the same time the radioactivity in the plasma was substantially lower after iodide had been given than after methylthiouracil. The urine output of radioactive iodine was increased by both drugs.

It is suggested that high plasma-iodide levels, besides blocking the organic binding of I^{131} in the thyroid, an action similar to that of methylthiouracil, also slow down the release from the gland of preformed radioactive thyroid hormone. This probably indicates a real reduction in hormone output from the gland, though a complete interpretation of the results is not possible without a knowledge of the specific activities of the iodine compounds present in the cycle.

One drawing; 6 graphs.

Radioactive Thyrotropic Hormone Preparations. Martin Sonenberg, Albert S. Keston, William L. Money, and Rulon W. Rawson. J. Clin. Endocrinol. & Metab. **12**: 1269–1286, October 1952.

In the investigation of thyroid physiology, the mode of action and fate of thyroid-stimulating hormone (TSH) needs to be better understood. There has been some success in labeling anterior pituitary hormone preparations with radioactive element and studying them in the experimental animal. ACTH labeled with I^{131} has been administered and the selective accumulation of radioactivity in the adrenal cortex has been recorded. This is evidence that histologic sites of action of preparations may be determined. Interesting information has also been obtained from the rate of breakdown and disappearance of labeled preparations from blood and organs, as well as the characteristic distribution of radioactivity.

Radioactive iodine cannot be used as a label with TSH, since the thyroid accumulates this element normally. Therefore the authors have investigated a TSH preparation coupled with diazobenzene sulfonic acid, labeled with S^{35}. This approach was suggested because of success in labeling insulin with radioactive diazotized *p*-iodo aniline.

A protein preparation (supplied by a large pharmaceutical manufacturer and having an assay value of 6-8 Junkmann-Schoeller units per milligram) was added to an S^{35}-labeled solution of diazobenzene sulfonic acid. One-hundred and ten day-old chicks (male) were used, those in the experimental group receiving daily injections of the preparation, while a control group received bovine serum albumin similarly labeled. Radioactivity was measured in the sacrificed animals in portions of the following organs: thyroid, adrenal, gonads, muscle, thymus, liver, blood, and orbital contents.

Experimental results are well tabulated and various organ concentrations are presented in graph form. The preparation under study showed a definite specificity for its target tissue and significant concentrations of radioactivity were obtained in the thyroid, gonads, and liver. The control group revealed, of course, no such specificity, which tended to rule out any difference due to variation in blood volume. The discussion contains a pertinent review of relevant literature.

One radioautograph; 7 graphs; 4 tables.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Observations on the Nodular Thyroid Gland with the Gammagraph. Herbert C. Allen, Jr., Frank J. Kelly, and James A. Greene. J. Clin. Endocrinol. & Metab. **12**: 1356–1372, October 1952.

The gammagraph is an automatically recording motor-driven "directional" scintillation counter which allows the outlining of an isotope-concentrating tissue in such a manner that a silhouette indicating the size and shape of the tissue can readily be obtained. The gammagram thus produced represents an image created by photons of gamma rays. The calcium tungstate scintillation counter acts as the detector or "camera." With this instrument it is possible to differentiate variations in degrees of radiation activity within the parenchyma of normal and abnormal thyroid glands. The present report concerns some observations in the study of nodular thyroids.

The tube is constructed so that there is good collimation of the radiation and is attached to the under surface of a motor-driven scanning platform. The patient is placed supine beneath the instrument, and the area to be scanned is determined according to clinical indications. The speed at which the tube moves depends upon the activity of the gland. The more active the gland the greater the speed in order to prevent superim-

position of deflections of the ink-writing pen which records the activity according to counts per second. A recording milliameter simultaneously registers count rate.

The authors have studied 175 gammagrams made on 68 patients. Representative patterns demonstrating relative size and shape of normal and of nodular thyroid glands are shown, together with photographs of the surgically removed or necropsy specimens, as well as radioautographs and photomicrographs.

The method used in calculation of thyroid weight with the scintillation counter and tracer doses of I^{131} has been reported in RADIOLOGY (**58:** 68, 1952). One point in technic is emphasized here—distance from the aperture of the counter to the skin must be short and constant. Observations show, for example, that at 0.5 cm. from the skin, calculated weight was 38.6 gm.; at 5.0 cm., 66.3 gm.; and at 10.0 cm., 78.9 gm., representing increases of 72 per cent and 104.6 per cent, respectively, over that at 0.5 cm.

With knowledge of the thyroid weight, accurate calculation of therapeutic doses of radioiodine is possible. The gammagraph is, therefore, a composite picture of what the surgeon and anatomist would see after dissection, combined with the information the physiologist could provide after study of radioautographs.

Characteristic gammagraph patterns are thought to be found with (1) solitary intrathyroidal nodules, hypofunctioning or hyperfunctioning, (2) multiple intrathyroidal nodules, (3) extrathyroidal masses displacing the normal thyroid gland, and (4) substernal thyroid extension. The pyramidal lobe is demonstrated with frequency.

Nineteen gammagraphs; 2 roentgenograms; 4 photographs; 6 radioautographs; 3 photomicrographs.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Practical Aspects of Laboratory Scintillation Counting. Raymond L. Libby, Christine M. Taylor, and Panchita B. Thomas. J. Lab. & Clin. Med. **40:** 641–648, October 1952.

The scintillation counter has proved to be a valuable instrument for the *in vivo* measurements of gamma-emitting radioactive areas. In laboratory sample counting it is possible to utilize this increased efficiency for the detection of gamma radiation to simplify counting technics.

A simple procedure is described for liquid gamma counting. A 5-milliliter volume of blood, plasma, urine, or other solution is pipetted into an ointment tin, 1 7/8 inches in diameter by 11/16 inch deep, the top is replaced, and the tin set in a holder mounted in the lead chamber at a fixed distance of 16 mm. from the surface of the solution to the aluminum window of the scintillation counter. One-tenth microcurie of I^{131} in 5 ml. of solution counted under the above geometrical conditions yields 217 net counts per second; this is a geometry of 5.9 per cent. This may be compared with a geometry of 16.8 per cent for beta counting (sample dried on a flat copper planchet) at the same distance from a Tracerlab 1.7 mg. per square centimeter mica end-window Geiger-Müller tube. If the surface of the 5 ml. liquid sample in the ointment tin is moved to a 3 mm. distance from the aluminum window of the scintillation counter, the geometry can be increased to 11.7 per cent. Under these conditions as little as 0.001 microcurie of I^{131} in 5 ml. of solution can be counted in approximately ten minutes with a counting error no greater than ± 5.0 per cent.

The day-to-day fluctuations in the count observed with a reference source have been less than those obtained with Geiger counting. In the authors' experience, the scintillation counter has had greater inherent stability than the Geiger-Müller tube. Even though the initial cost of a scintillation counter is considerably greater than that of a Geiger-Müller detector, its life expectancy is unlimited. Another advantage of scintillation counting is the ability of the instrument to respond to a much wider range of activities without coincidence losses, especially when it is well shielded.

Two photographs; 3 graphs.

The Determination of Cardiac Output by a Continuous Recording System Utilizing Iodinated (I^{131}) Human Serum Albumin. II. Clinical Studies. Walter H. Pritchard, William J. MacIntyre, William C. Schmidt, Bernard L. Brofman, and Douglas J. Moore. Circulation **6:** 572–577, October 1952.

The method of calculating blood volume in animals by obtaining dilution curves with a scintillation counter after injecting serum albumin tagged with radioactive iodine (I^{131}) has been previously described by the authors (Circulation **4:** 552, 1951. Abst. in Radiology **59:** 475, 1952). This paper describes the results in 12 examinations done on 11 patients and compares the findings with calculations made with the Fick principle. Good agreement was found, with a range of $\pm 8.3\%$ in the small group studied. Complete and rapid injection of the material must be made, and free flow from the arterial needle is necessary to prevent technical errors.

[If further studies confirm the validity of this procedure, it would certainly seem to involve fewer "man-hours" of laboratory work to calculate blood volume—Z.F.E.]

One photograph; 2 diagrams; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The Use of Radioactive Colloidal Gold (Au^{198}) in Pleural Effusions and Ascites Associated with Malignancy. E. R. King, Donald W. Spicer, F. William Dowda, Merrill A. Bender, and William E. Noel. Am. J. Roentgenol. **68:** 413–420, September 1952.

The authors present their experience with the intracavitary administration of radioactive colloidal Au^{198} in 16 patients with cancer involving the chest or abdominal cavity. The primary objective was reduction in fluid accumulation. A secondary objective was the relief of pleuritic or abdominal pain.

Radioactive colloidal gold was considered suitable for a number of reasons: (1) The half-life (2.7 days) is satisfactory for clinical use. (2) The emission consists of a moderately energetic beta particle (0.98 mev) and two soft gamma rays (0.12 and 0.41 mev). About 90 per cent of the ionization occurs in the first millimeter of the exposed serosal surface. (3) The particulate size is such that absorption by the vascular and lymphatic systems is negligible. Methods of production, handling, calibration of activity, administration, dosage, calculations, and personnel protection involved in the use of this material are discussed.

The 16 cases were selected only on the basis that each presented some degree of pleural effusion or ascites associated with a malignant neoplasm. Six were metastatic breast carcinomas with pleural effusion, 4 were

bronchogenic carcinomas with effusion, 2 were cystadenocarcinomas of the ovaries with ascites, 1 was lymphoblastoma of the mediastinum with fluid formation, 1 was generalized Hodgkin's disease with pleural effusion, 1 was adenocarcinoma of the rectum with extensive abdominal involvement and ascites, and 1 was a rhabdomyosarcoma of the chest with effusion. Ten of the patients had undergone major surgical procedures for their disease, and 13 of them had received full courses of roentgen therapy and/or nitrogen mustard. The type of case, dosage of Au^{198}, and evaluation of the results of therapy are presented in tabular form, and 4 typical case histories are included.

Four patients experienced marked relief, both from the standpoint of reduction of fluid accumulation and relief of pain. In 4 others these symptoms were moderately relieved. On the basis of these results, it is believed that the intracavitary use of radioactive colloidal gold should be accepted as a valid radiotherapeutic procedure. Conclusions as to prolongation of life or actual destruction of malignant tissue must await longer follow-up data and a larger number of case studies and autopsies.

Three illustrations; 1 table.

A. GREENBERG, M.D.
Mt. Sinai Hospital of Cleveland

A Study of Radiophosphate Uptake in Paramecium multimicronucleatum. Frederick R. Evans and Robert C. Pendleton. Biol. Bull. **103:** 190–194, October 1952.

It is important to know to what extent aquatic organisms concentrate ions in their bodies from their environment because of the implications in sewage and radioactive waste disposal problems. The authors describe an investigation made to find out if it is possible, by the use of radioactive elements, to tag microorganisms such as *Paramecium*, in order that an adequate evaluation of their place in food chains can more accurately be determined.

It was found that in a medium containing inorganic radioactive phosphorus, *Paramecium multimicronucleatum* becomes sufficiently radioactive for use in quantitative predation experiments. The greater the initial concentration of P^{32} in solution, the more radioactive the paramecia become. It is possible to measure the P^{32} uptake of a single individual. When food is absent, paramecia do not take in inorganic phosphate in solution. The phosphate is acquired in measurable amounts in their food. The phosphate taken in is rapidly lost from the paramecia, probably as a result of an organic turnover.

Paramecia in old cultures, especially cultures containing *Chlorella*, become more radioactive than those in other cultures, probably because the *Chlorella* which is ingested by the paramecia, absorbs much phosphate, and also because old cultures of paramecia are primarily non-dividing.

When washed by centrifugation, there is a leakage of P^{32} from the organisms over and above the normal turnover of phosphate.

Biological Studies on Stable and Radioactive Rare Earth Compounds. I. On the Distribution of Lanthanum in the Mammalian Organism. Daniel Laszlo, Daniel M. Ekstein, Ruth Lewin, and Kurt G. Stern. J. Nat. Cancer Inst. **13:** 559–573, October 1952.

The object of the investigation reported in this paper was to study the distribution of lanthanum in normal and tumor-bearing mice as a function of time, dosage, route of administration, and chemical state of the element (ionized and non-ionized compounds).

A solution of stable lanthanum, La^{139}, containing La^{140} as a tracer, was injected intravenously, intraperitoneally, and subcutaneously into albino mice. At selected time intervals the animals were sacrified and histologic and radioautographic studies were performed on small samples of the organs.

The results of the experiment are stated as follows:

Lanthanum chloride injected intravenously was taken up rapidly by various tissues, the concentration being highest in liver and spleen and low in the skeletal system. The concentration in the lung was very low until a critical dose level was reached, whereupon it rose sharply.

Minimal transport occurred when lanthanum chloride was injected intraperitoneally or subcutaneously. This suggests its intracavitary or intratumoral use.

Lanthanum complexes are distributed more homogeneously than the ionized forms.

The implications for therapy of tumors with rare earth radioisotopes are discussed. These are based on the ability of lanthanum to form complexes with nucleic acids, especially desoxyribonucleic acid, which are insoluble within the physiological *p*H range.

Four photomicrographs; 1 graph; 5 tables.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

RADIATION EFFECTS

Bone Growth Disturbances After Irradiation of Hemangiomas. H. Mau. Strahlentherapie **89:** 227–242, 1952. (In German)

After stressing that radiation therapy of hemangiomas is today considered the method of choice, and after quoting large series of cases (*e.g.*, that of Baensch numbering 1,250) in which it has produced no interference with skeletal growth, the author analyzes in detail 5 cases from the German literature in which bone disturbances followed irradiation and adds one case.

Five of the 6 cases occurred after external therapy and 1 case after interstitial therapy. Three patients were younger than one year. In 3 instances ulceration occurred after the irradiation. In the cases treated with radium the total dose at the epiphysis was more than 1,800 r. The author recommends that the total dose at this site be kept below 500 r and that treatment of children in the first year of life be avoided.

In addition to the 6 cases forming the basis of this paper, the author cites a case reported by Frantz in RADIOLOGY **55:** 720, 1950.

Three roentgenograms; 1 photograph.

ULRICH K. HENSCHKE, M.D.
Ohio State University

Multicentric Mammary Cancer Developing in Previously Irradiated Breast. James R. Lisa, George T. Pack, and Joseph Gioia. Am. J. Roentgenol. **68:** 452–456, September 1952.

A 29-year-old woman had histologically proved

Hodgkin's disease of the right anterior chest wall. Beginning in 1941, she received high-voltage x-ray therapy about twice a week for three years, with "repetition of dosage and protraction of the irradiation in such a fashion it would be impossible to estimate the dose received." When first examined by the authors, in April 1944, she showed evidence of considerable radiation damage in the skin and associated fibrosis of the breast. Because of residual Hodgkin's disease, additional therapy, regarded as palliative, was given as follows: 1,200 r to the anterior and posterior chest wall, and to the right axilla (250 kv., 1.5 mm. Cu filter). Marked regression took place and for the next seven years no x-ray therapy was given.

Early in 1951, a small nodule 3 cm. in diameter was found in the upper inner quadrant of the right breast. On aspiration biopsy, this was reported as mammary cancer. Radical mastectomy was done with considerable difficulty because of scarring and was followed by impaired wound healing. Pathologic examination revealed multiple carcinomas of the right breast, metastatic to many lymph nodes in the right axilla.

Nine photomicrographs: 1 photograph.

GEORGE R. KRAUSE, M.D.
Mt. Sinai Hospital of Cleveland

Histological and Cytological Studies of the Vaginal Mucosa Treated by Intravaginal X-Ray Therapy. H. Tischer and E. Schüller. Strahlentherapie **89**: 456–468, 1952. (In German)

The histologic and cytologic changes in the vaginal mucosa after intravaginal fractionated x-ray therapy were investigated by vaginal biopsy in about 200 patients. The extremely high radiation tolerance of the vaginal mucosa, already well known, was confirmed. The maximum surface dose at which *restitutio ad integrum* will take place is estimated to be approximately 30,000 r.

The hypothesis is advanced that the high tolerance of the vaginal mucosa is due to active cell migration covering the defects caused by cell destruction. Such an active cell migration is not possible in cornified epithelium.

Eleven photomicrographs.

ULRICH K. HENSCHKE, M.D.
Columbus, Ohio

A Satisfactory Colpocleisis Combined with Anal Closure After Severe Damage to Bladder and Rectum by Radium. A. W. N. Druitt. Brit. M. J. **2**: 856–857, Oct. 18, 1952.

The author describes the case of a young woman who was discovered, at the age of 20, to have a carcinoma of the cervix and anterior vaginal wall. She was treated by radium (dosage not stated) over a period of eighteen months. Four months later she began to have a brown vaginal discharge followed by passage of urine and feces *per vaginam*. On rectal examination, a rectovaginal fistula was demonstrated and, after a left lower colostomy to rid the vagina of contamination, a vesicovaginal fistula was demonstrated as well.

Colpocleisis (vaginal closure) was performed in stages and, because of incontinence of the anal sphincter, the anus was also closed. The urethra was closed over in the performance of the colpocleisis. As a result of these procedures, urine drained through the distal limb of the colostomy and feces through the proximal limb. The "new bladder" comprised the bladder, vagina, rectum, and distal colon.

Following the final operative stage, the patient gained weight and improved in health. Intravenous pyelograms showed good function of both kidneys. She was living and well two and a half years after the final operation and six and a half years after the diagnosis of carcinoma.

[It should be noted that there was only a four-month interval between cessation of treatment and manifestation of fistulas. Without some indication of the treatment scheme and the dosage employed, ascribing those complications to radium damage might be open to some question.—J.F.R.]

There is a short review of pertinent literature.

One roentgenogram; 2 photographs.

JOHN F. RIESSER, M.D.
Springfield, Ohio

Experimental Studies in Metal Cancerigenesis. II. Experimental Uranium Cancers in Rats. W. C. Hueper, J. H. Zuefle, A. M. Link, and M. G. Johnson. J. Nat. Cancer Inst. **13**: 291–305, October 1952.

In view of the rapidly increasing mining and milling of uranium ores, it appeared to the authors important to investigate whether or not cancers might develop from a tissue in which metallic uranium was placed in the form of a depot. There would be produced, thereby, a high local concentration of uranium over a long period of time.

Powdered, alpha-ray-emitting uranium incorporated in lanolin was used in two experiments. For controls, arsenic, asbestos, and chromium in bases of gelatin and lanolin were introduced.

In the first experiment 0.05 c.c. of 25 per cent uranium (by volume) in suspension was injected into the femoral cavity through a small hole in the lower end of the femur. Thirty-three albino rats were used and necropsy studies were made on all. Sarcomas developed in the thigh in 11 rats, and in 4 of these there were metastases to the inguinal, abdominal, and/or mediastinal nodes and/or lungs. Most of these tumors appeared to arise from periosteum.

For the second experiment the same amount of uranium suspension was introduced into the pleural cavity at monthly intervals for six months. None of the 33 animals used survived more than eighteen months after the injections were begun. Moderate to severe acute as well as chronic renal lesions developed in an appreciable number of rats, and a distinct reduction in the number of erythrocytes was observed. Two sarcomas developed in the chest wall at the sites of injection.

The authors feel that the evidence presented leaves no doubt that parenterally introduced powdered metallic uranium, suspended in lanolin, and deposited as described, produces systemic metallotoxic reactions. It is uncertain whether the sarcomas were due to a metallocarcinogenic action of uranium or were caused by a radiocarcinogenic effect of this radioactive chemical. It is felt, however, that the observations reported demonstrate that localized uranium deposited in the tissues of rats, creating a high concentration of the element in circumscribed areas, and the prolonged action of the uranium in "non-toxic" or low toxic quantities

on the cells in the immediate vicinity of such foci exert a definite carcinogenic effect.

One roentgenogram; 7 photomicrographs.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

Squamous-Cell Carcinoma of the Forestomach in X-Irradiated Mice Fed 9,10-Dimethyl-1,2-Benzanthracene, with a Note on Failure to Induce Adenocarcinoma. Erkki A. Saxén. J. Nat. Cancer Inst. **13:** 441–453, October 1952.

Carcinoma of the glandular stomach has not been induced by feeding carcinogenic hydrocarbons. In the experiment reported here, an attempt was made to alter the function and structure of the glandular stomach of mice by roentgen irradiation of the gastric region. No tumors were actually produced in this organ during the time the mice survived but there were interesting findings in the forestomach.

The mice were divided into 7 groups. To some, carcinogens were administered without irradiation, some were irradiated but received no carcinogen, while others received a carcinogen following varying amounts of radiation delivered to the upper abdomen.

In the irradiated mice, changes such as edema and degeneration of the epithelial cells of mucosa and stroma occurred in the glandular mucosa and, as others have observed, there was temporary depression of acidity. These changes were thought to be the results of the irradiation. In the forestomachs, squamous-cell carcinomas developed in a high percentage of cases. No tumors of the intestine were produced.

The authors were not able, therefore, to alter the glandular mucosa and provide a focus for penetration of carcinogen subsequently fed to the animal. This is in accord with the experience of others.

Ten photomicrographs; 1 table.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

X-Irradiation and Bacteremia. Studies on Roentgen Death in Mice, IV. J. W. Osborne, H. S. Bryan, H. Quastler, and H. E. Rhoades. Am. J. Physiol. **170:** 414–417, August 1952.

X-irradiation produces severe damage to the intestinal epithelium and causes invasion of the blood stream by intestinal bacteria. It might therefore be assumed that bacteremia and intestinal damage are closely related. The authors, however, describe experiments which indicate that these are two quite distinct reactions. Bacteremia is not a factor in acute intestinal radiation death in mice, nor is irradiation damage of the intestine a necessary factor in post-irradiation bacteremia, though direct intestinal irradiation does facilitate bacterial invasion of the blood stream.

One table.

Decreased X-Ray Sensitivity of Mice Following the Administration of Ethanol. Leonard J. Cole and Marie E. Ellis, with the technical assistance of Ray Ferkel. Am. J. Physiol. **170:** 724–730, September 1952.

In view of the experimental data of Burnett *et al.* (Proc. Soc. Exper. Biol. & Med. **77:** 636, 1951), which showed a reduction in radiosensitivity of *Escherichia coli* exposed to x-rays in the presence of ethanol, and since catalase activity is accelerated by ethanol as well as by sodium nitrite, it was considered of interest to determine whether administration of this compound would modify the response of animals subjected to x-irradiation.

The animals used in the investigation were LAf_1 mice of both sexes. Radiation factors were: 250 kv.p.; 15 ma.; filter, 0.5 mm. Cu plus 1 mm. Al; half-value layer 1.5 mm. Cu; skin-target distance, 100 cm.; dosage rate 25 r/min., as measured with a Victoreen r-meter placed in air at the position of the mice. Each radiation dose was delivered in a single exposure. During irradiation, the mice were contained in individual, perforated Lusteroid centrifuge tubes, placed radially on a circular wooden turntable platform which rotated at 3.5 rpm to obtain uniformity of radiation dosage.

A single pre-irradiation intraperitoneal injection of 1.25, 2.5 or 3.75 ml. of 25 per cent ethanol per 100 gm. body weight was found to reduce the mortality of the mice exposed to mid-lethal and supralethal irradiation. Within the limits of ethanol dosage studied, the degree of radiation protection at 750 r was a linear function of the amount of ethanol administered. The estimated LD 50 for mice receiving 3.75 ml. of 25 per cent ethanol per 100 gm. is 814 r, compared with an LD 50 value of approximately 620 r for control mice. The protective action of ethanol was further borne out by the minimal body weight losses in the ethanol-treated mice as contrasted with the control mice. Pretreatment of x-irradiated rats with ethanol, in doses equivalent to those which protect mice, failed to elicit any radiation protection.

The hypothesis relating the protective action of ethanol to its potentiating effect on catalase activity is presented and discussed.

Three graphs; 1 table.

Weight Changes and Water Consumption of Rats Exposed to Whole-Body X-Irradiation. L. E. Nims and E. Sutton. Am. J. Physiol. **171:** 17–21, October 1952.

The weight changes and water consumption of young male rats after whole-body x-irradiation were re-examined to determine whether they could serve as useful indices for biological dosimetry and also to gain additional information about the physiology of the radiation response.

Rats were selected for experiments on the bases of steady daily weight gains and obvious freedom from infection. Radiation factors were 30 ma., 250 kv., filtration 1 mm. Al and 0.25 mm. Cu placed in the beam, half-value layer 0.9 mm. Cu. Animals were exposed in a circular, sectored, wire and plastic box. A calibrated integrating Victoreen meter, the ionization chamber of which was placed in an empty sector of the exposure box at the mid-position of the rats' bodies, was used for determining all doses. The dose rate was approximately 100 r/min.

The weight loss of a fasting rat of 180 to 380 gm. is independent of the initial weight and is unaffected by 500 r whole-body x-irradiation. This implies that irradiation does not greatly alter the overall metabolism of the animal or the degree of hydration of the tissues.

Fed irradiated rats lose weight for a period of time which is proportional to the dose received and then with sublethal doses grow at a rate parallel to that of control animals. The time required to regain the weight of the day of irradiation in 200-gm. rats is a linear function of

the dose up to 600 r. This index is reproducible enough to detect increments of 50 r in dose from the average weight changes of a group of five rats.

Fed irradiated rats show two periods of polydipsia. The first period occurs within twenty-four hours after exposure. The second period occurs after a time interval of forty-eight hours, or longer in proportion to the dose received, and is associated with recovery and resumption of normal food intake and growth of the exposed animals.

Six graphs; 2 tables.

Cholinesterase Activity, Weight, Water Content and Pathology of Small Intestine of Rats Subjected to X-Radiation. Robert A. Conard. Am. J. Physiol. **170:** 418–425, August 1952.

In 1951 (Am. J. Physiol. **165:** 375, 1951. Abst. in Radiology **58:** 633, 1952), the author reported increased tone and motility of the rat small intestine (*in vivo*) during and after x-irradiation with doses as low as 100 to 200 r. By studying the effect of various drugs on kymographic tracings of these changes, he concluded that the increased motility was due to stimulation of the cholinergic nerves in the intestine. The possibility that irradiation might alter neurohumeral agents in such a way as to produce such a phenomenon was considered. If irradiation either increased acetylcholine synthesis or release, or inhibited the enzyme, cholinesterase, the resulting accumulation of acetylcholine in the intestine might account for the increased motility observed.

Cholinesterase activity of the small intestine was studied in 52 control and 153 experimental animals at the following times after 500 r irradiation (approximately an LD 30-thirty days): 0–3 hours, 3–10 hours, 10–15 hours, 15–20 hours, each successive day through 8 days, 10 days, 14 days, and finally on the twenty-first to twenty-third days. The animals were irradiated in aluminum cages, 3 to a cage, and placed above a cone so that the beam passed anterior-posterior. Radiation factors were 200 kv.p., 25 ma., cone size 20 × 20 cm., half-value layer 0.82 mm. Cu, filter 0.25 mm. Cu and 1 mm. Al [text reads half-value layer 0.82 mm.^{3}, filters 0.25 mm.^{3} and 1 mm. Al, which is obviously an error], back-scatter material 0.75 cm. masonite, target-skin distance 50 cm., dose rate 44 r/min.

The cholinesterase activity (measured by the colorimetric method of Hestrin) of the small intestine showed significant depression at 15 to 20 hours after 500 r and reached a maximum of nearly 60 per cent depression by the fourth day, recovering slowly, approaching normal values by the twentieth to twenty-fourth day. Changes in total body weight and in the weight and water content of the small intestine showed little parallelism, either in degree or in time sequence with cholinesterase activity. The gross appearance of the small intestine paralleled the cholinesterase activity more closely than did the histologic appearance. Correlation of enzyme changes with intestinal motility was not apparent.

One graph; 3 tables.

Observations on Serum Prothrombin Conversion Accelerator in Radiation-Induced Pancytopenia. George J. Jacobs, Eugene P. Cronkite, and Sidney G. White. Am. J. Physiol. **170:** 390–395, August 1952.

The objectives of the present investigation were (1) to determine if radiation-induced hemorrhage is associated with a deficiency of the "serum prothrombin conversion accelerator" (SPCA) or with the impairment of the formation of active SPCA and (2) to determine the relation of SPCA evolution and synthesis to pancytopenia and aplasia of the hemopoietic tissues. (Serum prothrombin conversion accelerator is a substance capable of accelerating the conversion of prothrombin to thrombin in a one-stage prothrombin assay system.)

Twelve male mongrel dogs were used in the investigation. Eleven of the animals received 600 r whole-body x-irradiation by the bilateral exposure technic (Radiology **57:** 90, 1951). Physical factors were 2,000 kv.p., 1.5 ma., half-value layer 4.3 mm. lead, 15.0 (± 0.15) r/min. in air at a distance of 2 meters. The twelfth dog served as a control. The SPCA studies were begun on the eighth post-irradiation day. All irradiated dogs died between the ninth and fifteenth day post-irradiation.

The authors found that the impaired evolution of SPCA in the irradiated dog is not due to a deficiency of the precursor of SPCA. The prolonged clotting time associated with radiation-induced thrombocytopenia results in a high residual prothrombin when blood is permitted to clot spontaneously with a consequent very slow evolution of SPCA. More than normal amounts of SPCA are evolved when the prothrombin conversion is accelerated by mechanical or chemical means. Transfusion of normal serum did not correct the coagulation defect of radiation sickness in 2 dogs. SPCA is not dependent upon an intact lymphatic apparatus, bone marrow, or the presence of platelets.

Two tables.

Effect of Altitude-Induced Polycythemia and Reticulocytosis on Tolerance of Rats to Radiation. Willie W. Smith, Walter S. Cool, Falconer Smith, and Paul D. Altland. Am. J. Physiol. **170:** 396–400, August 1952.

The experiments reported here were designed to study the relationship between altitude-induced erythroid hyperplasia and radiation lethality, and to examine the effect of polycythemia on survival, leukopenia, and anemia following irradiation.

Rats of the Sprague-Dawley strain were used in one part of the investigation and Holtzman rats in the other. The rats were irradiated at ground level, six at a time, in a partitioned Presdwood container where treatment groups were represented equally. Radiation factors were 200 kv., 20 ma., 0.25 mm. Cu and 0.51 mm. Al added filtration, and 75 cm. target distance.

(1) Rats in which polycythemia had been induced by repeated exposures to simulated high altitude showed only a relative anemia following irradiation. These rats, however, had a lower tolerance to 625 r or 760 r (but not to 525 r) than did ground-level controls. (2) In rats where the altitude exposures were discontinued at the time of irradiation, the harmful effect persisted. (3) Rats showing reticulocytosis while the degree of polycythemia was still slight also showed a lower tolerance to radiation than did ground-level controls. (4) It is concluded that the observed decrease in tolerance to irradiation is associated with bone marrow hyperplasia at the time of irradiation.

Two graphs.

Biological Evaluation of Skin Effects of the 23 mev Betatron. Lewis L. Haas, Roger A. Harvey, and John S. Laughlin. Am. J. Roentgenol. **68:** 644–653, October 1952.

The authors compared the biological efficiency of 23-

mev betatron roentgen-rays with 200-kv. radiation in the production of erythema and epilation of the skin in rabbits. The animals were immobilized without anesthesia and the lateral surfaces of the hind legs were irradiated. Three fields, 1 cm. in diameter, on one leg were exposed to 23-mev roentgen rays at an 80 cm. target-skin distance, 120 r/min. Symmetrical fields on the opposite leg were exposed to 200-kv. rays at 40 cm. target-skin distance, 0.75 mm. Cu half-value layer, 0.5 mm. Cu, plus 2 mm. Al inherent filter only, 25 ma., 80 r/min. (skin dose). With the betatron, a 4-cm. water-equivalent lucite block was placed against the skin so that the 100 per cent dose of the beam would be at the skin surface. Doses of 800 to 6,600 r were given.

Reactions were carefully observed to completion. Comparison showed that the efficiency of the 23-mev betatron irradiation as compared with the 200-kv. was approximately 0.56 for the erythema on the rabbit skin. For epilation of the rabbit skin, the efficiency of the betatron rays was 0.67. The authors thus demonstrate that the same efficiency ratio does not hold for different irradiation reactions. They believe that the ratio as to tumor dose in human patients is approximately 0.60. The quantitative difference in biological effectiveness does not, however, in any way influence the advantages and usefulness of the betatron.

Six photographs; 4 tables.

LAWRENCE A. DAVIS, M.D.
University of Louisville

A Quantitative Study of the Effects of X Radiation on Cells in Vitro. Thomas R. Reid and Margaret P. Gifford. J. Nat. Cancer Inst. **13**: 431–439, October 1952.

The authors have made use of a quantitative technic for the determination of cell population in tissue cultures to study the dose response pattern to various amounts of roentgen radiation, with a view to establishing a reference point for further work in radiation physiology studies using this method. Mouse fibroblasts were used for their experiments. The technic, which has been described by others, is briefly summarized here. Doses of 250 r, 500 r, 750 r, 1,000 r, and 2,000 r were administered to the tissue suspended in nutrient media. The results provide a well defined baseline.

The authors feel that the response to the dose of 500 r is of special interest, as the growth curve suggests that the effect is such as to produce death of a great number of cells after several divisions, while the remainder escape and eventually repopulate the culture to the extent that complete recovery is demonstrable on a numerical basis. At higher dosages (1,000 and 2,000 r), the immediate effect is so pronounced that no cultures are able to recover. As one would expect, doses of 750 r are only partially lethal.

Two photographs; 4 graphs.

LAWRENCE R. JAMES, M.D.
Boston, Mass.

Effects of X-Rays upon Haploid and Diploid Embryos of Habrobracon. A. M. Clark and C. J. Mitchell. Biol. Bull. **103**: 170–177, October 1952.

The authors have been studying the effects of x-rays on haploids and diploids of the parasitic wasp, *Habrobracon*, during different stages of its life cycle in order to determine to what extent genome number can be correlated with radiosensitivity. Comparison of radiosensitivity during the pupal, prepupal, and larval stages has shown that diploids are more resistant than haploids. The present paper reports on radiosensitivity during the early embryonic stages. Physical factors for the irradiation were: 182 kv., 25 ma., inherent filter equivalent to 0.2 mm. Cu, output intensity 110 r per minute. Doses ranged from 27.5 to 440 r.

The investigation showed that the stage of development at which the irradiation is administered is important in determining the relative sensitivity between the haploids and diploids. When irradiation is administered to embryos during cleavage, haploids are more resistant than diploids; with administration immediately after cleavage has been completed (blastema stage), haploids and diploids are equally radiosensitive.

Embryos irradiated during cleavage or early blastema are deleteriously affected during the egg stage or not at all. Those that hatch complete postembryonic development normally. Older embryos when irradiated may hatch, but postembryonic development is slowed down and many of the individuals are arrested in development as larvae. Hatchability, therefore, is not an adequate criterion of radiosensitivity for older embryos.

Embryos that are irradiated during cleavage and fail to hatch are arrested in cleavage or in early blastema. The nuclei are arrested at interphase and become enlarged up to four times the diameter of untreated nuclei.

Since the differential radiosensitivity between haploids and diploids depends upon the stage of development at which irradiation takes place, it is difficult to pose a single hypothesis that will account for these facts. It seems reasonable to consider that the relative sensitivities of the cellular materials change during development and that different mechanisms may be primarily involved at different stages.

Four tables.

A New Protector Against X-Radiation. A. M. Bacq and A. Herve. Schweiz. med. Wchnschr. **82**: 1018–1020, Oct. 4, 1952. (In French)

The theory of the indirect action of ionizing radiations has liberated radiochemistry and radiology from the concept of the "target," which paralyzed them. An electron may be discharged from one water molecule and be carried to another molecule of water to form an OH^- ion and an uncharged atom of hydrogen:

$$H_2O - e^- = H_2O^+$$
$$H_2O + e^- = OH + H\cdot$$

The H_2O^+ is very instable and is hydrolyzed into $OH\cdot + H^+$ or reacts with another molecule of water $H_2O^+ + H_2O = H_3O^+ + OH\cdot$. Multiple combinations are possible, especially if, as is the case in biology, oxygen is found dissolved in the water. Thus, it is reasoned, reducing agents should protect against effects of ionizing radiations.

Cystine and reduced glutathione have been efficacious, and cystine inefficacious, in the protection against ionizing radiations. For about a year the authors have noted the importance of function of the amine group ($-NH_2$) in radioprotection. Simple methylamine in a dose of 2 mg. per mouse gives protection of 30 to 70 per cent against 700 r. Only 2 per cent of control C57 mice survive 700 r.

Dale demonstrated the favorable effect of sulfur

which incited the authors to study the effects of B-mercaptoethylamine, which possesses both the amine function and the thiol group, on the most simple hydrocarbon support possible: $HS—CH_2—CH_2—NH_2$. A dose of 3 mg. per 20-gm. mouse gives almost 100 per cent protection against 700 r. It requires a dose of 1,300 r to give the same mortality percentage suffered by controls receiving 700 r. This protection, however, is of short duration due to rapid excretion and metabolism. An hour after injection, more than two-thirds of the protection has disappeared.

Man supports the slow intravenous injection of 200 to 400 mg. of B-mercaptoethylamine without difficulty. More than 35 patients have been relieved of post-irradiation symptoms by two to four injections.

The disulfurous compound of bis-aminoethane or cystinamine,

$$\begin{array}{l} S—CH_2—CH_2—NH_2 \\ | \\ S—CH_2—CH_2—NH_2 \end{array}$$

is equally efficacious in mice but produces symptoms of nitritoid crisis (vasodilatation, tachycardia) in man.

One chart; 3 tables.

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Graying of Hair Following Epilating Doses of X-Rays. Israel Zeligman. Arch. Dermat. & Syph. **66:** 627–629, November 1952.

During the past five years the author has treated 58 patients for tinea capitis. Sixteen of these were treated topically only. One patient received a spot-epilating dose of x-rays with an excellent result. Of 41 patients who were given a complete epilating dose of x-rays, 37 have been adequately followed until the complete return of non-infected hair. Three of this number displayed gray hairs at six to seven years of age. Each of the 3 children had a parent with premature graying of the hair.

The hypothesis is suggested that hair melanoblasts with hereditary predisposition to early loss of function are rendered ineffective even earlier by roentgen irradiation.

Growth of Tumor Fragments X-radiated *in Vitro* Following Pretreatment with Cysteine. B. Vincent Hall. Cancer Research **12:** 787–792, November 1952.

The author presents data on the survival and growth of mouse tumor fragments following x-irradiation *in vitro* with and without prior treatment with 0.008 M cysteine. The radiation factors were 200 kv., 15 ma., with a 2 mm. Al filter, and a target distance of 12.7 cm. The dose rate as measured in air with a Victoreen r meter was close to 1,030 r per minute. In some experiments measured dose rates as much as 2 per cent higher or lower were employed. The tumor fragments were irradiated while they lay in a single layer on the bottom of a culture dish, slightly covered with about 0.25 c.c. of the solution with which they had been treated. Subcutaneous, bilateral axillary implants were made soon after irradiation. Over 400 NaCl- and cystine-treated and 100 cysteine-treated, non-irradiated implants were used as controls. In no case did a non-irradiated control implant fail to grow, nor did any host survive the effects of the control tumors.

The prevention and alleviation of radiation injury of mammalian tumor cells by cysteine was clearly demonstrated. The radiation dose had to be increased by about 18 per cent to effect equivalent injury of cysteine-treated implants. Delay in initiation of growth by tumor fragments following implantation was increased by irradiation effects, and the increase in latency was found to be determined by an exponential function of the radiation dose. Cysteine in the ambient medium was not found to be an effective agent in reducing the radiosensitivity of tumor fragments. The results indicate that the prevention and alleviation of the effects of ionizing radiations upon cells by pretreatment with cysteine and related compounds is due to the intracellular action of their sulfhydryl groups.

Three graphs; 2 tables.

Impairment of Antimicrobial Defenses Following Total Body Irradiation of Mice. H. S. Kaplan, R. S. Speck, and E. Jawetz, with the technical assistance of Janice Paull. J. Lab. & Clin. Med. **40:** 682–691, November 1952.

A preterminal bacteremia is quite consistently demonstrable in animals dying about eight to fifteen days after systemic x-irradiation in the LD 50 range. The organisms have in most instances been identified as members of the normal bowel flora, and it has been presumed that they gain access to the tissues as a result of injury to intestinal epithelium. Of perhaps greater significance than the entry of bacteria into the blood stream is the apparent inability of normal removal mechanisms to function adequately under these circumstances. The series of experiments described in the present paper were designed to elucidate the nature of the defect induced by irradiation in the normal antimicrobial defense mechanisms.

A standard subacute infection was induced by a single intramuscular injection of 100 LD 50 of a beta hemolytic streptococcus into the thigh of black mice. In most experiments the animals were infected one to three days after irradiation. Groups of 30 to 40 animals were observed closely for the development of illness, and deaths were recorded daily. In parallel groups similarly treated, 3 to 5 mice per group were sacrificed daily, and semiquantitative cultures were made. Factors of the irradiation were 120 kv.p., 9 ma., 0.25 mm. Cu plus 1.00 mm. Al added filter, 30 cm. mouse-target distance, 32 r per minute.

The infection was found to spread more rapidly in the mice subjected to single total-body x-ray exposures in the LD 50 range than in non-irradiated controls. Cumulative mortality curves in the two groups were parallel but the average survival time was significantly reduced by irradiation. Using the average day of death as a criterion, impairment of resistance was apparent within twenty-four hours after irradiation at this dose level, increased to a maximum between three and seven days after irradiation, and gradually returned to normal by fifteen days after treatment.

Penicillin in large doses started within twenty-four hours after infection was effective in eliminating deaths due to bacteremia in the irradiated mice, despite the presence of a profound leukopenia. Aureomycin was somewhat less effective at the dose levels studied.

In a preliminary experiment, spleen shielding failed to protect the mice against the profound impairment of antimicrobial defenses caused by systemic irradiation. It has since been shown that this response may be genetically conditioned, in that spleen shielding of mice of this strain confers relatively little protection

against the lethal effect of irradiation in contrast to the striking protection observed in other strains.

Three graphs; 2 tables.

The Effect of Oxygen Concentration upon the Induction by X-Rays of Melanotic Tumors in *Drosophila melanogaster*. Henry L. Plaine and Bentley Glass. Cancer Research **12**: 829–833, November 1952.

The authors' studies of a particular stock of *Drosophila melanogaster* show that it contains a suppressor gene that inhibits the manifestation of erupt. This mutant produces a particular type of abnormal growth, taking the form of an eruption of hypodermal tissue through the eye, nearly always in its very center. The action of the suppressor-erupt gene is blocked when the embryos are irradiated. The same stock also possesses an unprecedented tendency to produce melanotic tumors when the embryos are irradiated (1,000 r x-rays).

Both the incidence of tumors and the incidence of erupt increase significantly and linearly for increasing O_2 concentrations at the time of irradiation, over the range from 0 to 20 per cent. Although there is only a small further increase as the shift is made from air to pure oxygen, this increase is also significant for both effects. In addition, both the mortality and duration of development also increase with increasing oxygen concentration at the time of irradiation.

The same differential responses to x-rays in varying concentrations of oxygen also occur in another tested stock, Oregon-R, which is not closely related to the suppressor-erupt stock, but in the case of the Oregon-R stock all responses show a much lower incidence. Thus, it seems possible that the system affected is a general one, at least for *Drosophila melanogaster*.

The incidence of melanotic tumors in both stocks is slightly, but significantly, increased by exposure of the embryos for ten minutes to pure oxygen, without irradiation. It is decreased by similar exposure to pure N_2. In this respect the tumor response differs from the response of suppressor-erupt, which is not affected by oxygen alone, in the absence of irradiation.

One chart; 3 tables.

Nitrogen Metabolism Following Whole Body X-Radiation. Gordon E. Gustafson and Simon Koletsky. Am. J. Physiol. **171**: 319–324, November 1952.

The present study was designed to determine whether the decrease in weight in rats following whole-body x-irradiation is due merely to starvation or if there is, in addition, evidence of alteration in metabolism. This was done by comparing the nitrogen balance of rats given whole-body irradiation with that of non-irradiated control animals receiving the same quantity of food. Physical factors were: 200 kv., 15 ma., mean target distance 33.5 cm., 0.5 mm. copper and 1 mm. aluminum filtration, half-value layer 1.35 mm. copper, dosage rate approximately 130 r/min.

For the first six days following 660 r of whole-body irradiation the rats were found to be in marked negative nitrogen balance. This cannot be accounted for on the basis of decreased food intake alone. Additional factors are tissue destruction and probably alteration in metabolism due to irradiation. A second period of negative nitrogen balance may occur in irradiated rats during the second or third week post-irradiation. Here blood loss or infection may be contributing factors. Water intake in the 660 r irradiated rats decreased markedly on the second and third day post irradiation while the intake of the control rats increased markedly. Urinary output in both groups followed the same trend as the water intake. For the first three days following whole-body irradiation, rats which received 660 r showed a greater nitrogen excretion and a more negative nitrogen balance than did animals receiving 1,000 r.

Two graphs; 4 tables.